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BY GEORGE J. YOUNG

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Valuation of California Limestones

BY JAMES M. HILL

Relative Scarcity and Nearness to Markets Are Most Important Factors

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Storage of Ore in Stockpiles

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Efficiency Engineering, Supervision, and Influence of the Personal Factor

The New I-R Drill Steel

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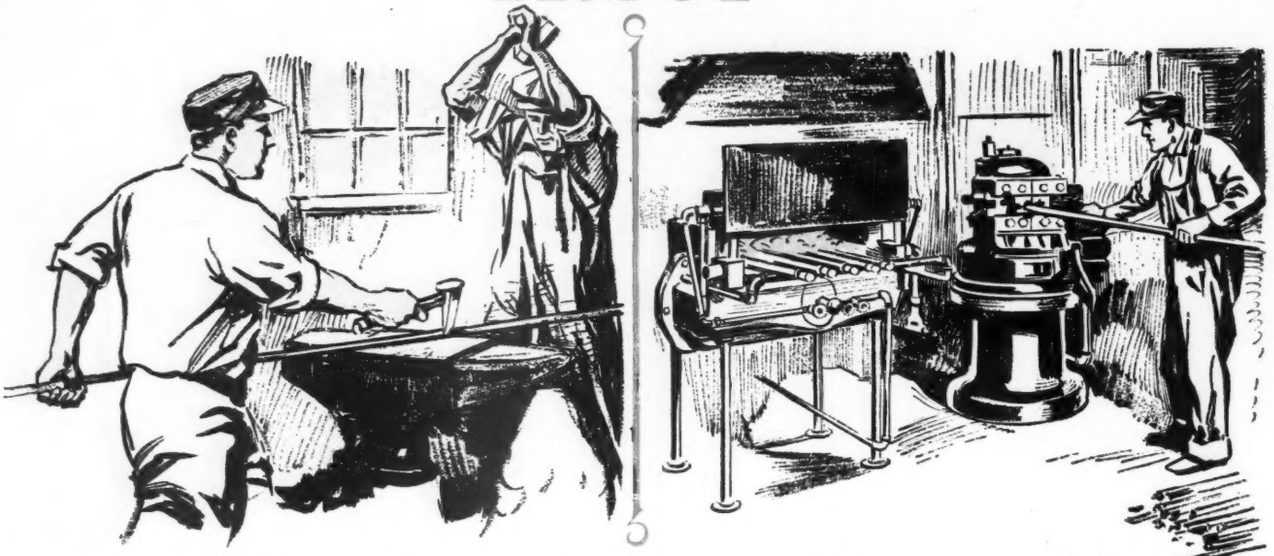

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A. W. ALLEN, *Editor*

Associate Editors: E. H. ROBIE, A. H. HUBBELL, New York. GEORGE J. YOUNG, San Francisco
Assistant Editors: W. N. P. REED and H. D. KNIGHT, New York. *Publishing Director:* H. W. CLARKE

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Contents

July 27, 1929

Editorials	121	By the Way	142
Storage of Ore in Stockpiles By A. L. Egan	124	Consultation	142
Production of Aluminum Increased in 1928	126	Personal Notes	143
Valuation of California Limestones By James M. Hill	127	Industrial Progress	144
Notes on Arizona Copper Mining Progress By George J. Young	129	Mining News	147
Beneficiation of Southwestern Manganese Ores May Be Practicable	132	Market and Financial News	154
Scientific Management in Mining By Prof. S. J. Truscott	133	Market Report	158
Combustion of Pulverized Coal Occurs in Four Stages	137	Mining Stocks	160
Useful Operating Ideas	138	Service Directory	33
Comment and Criticism	140	Searchlight Section	34-36
		What and Where to Buy	38, 40
		Advertising Index	42

The Anaconda Issue—August 24

The months of planning which have been devoted to preparing the story of the great Anaconda enterprise are destined to come to fruition in the August 24 issue. A greatly enlarged editorial section will contain matter of vital interest to geologists, miners, mill men, smelters, refiners; metal manufacturers, sellers, and users; and mining engineers and metallurgists generally.

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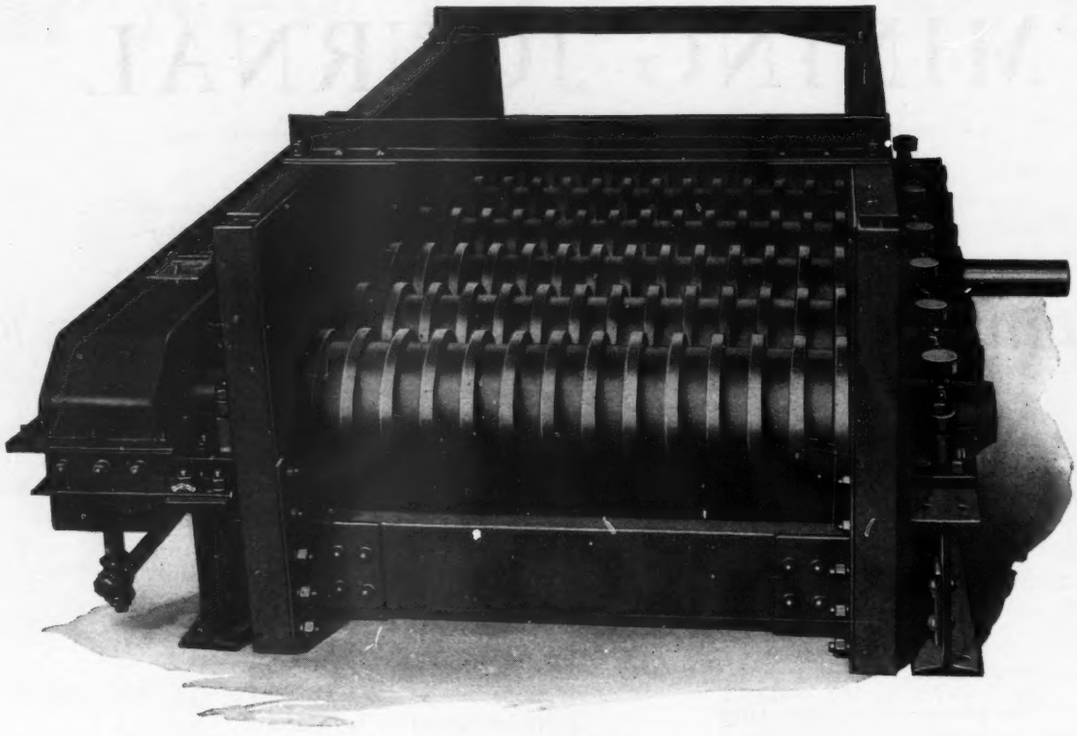

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Start Promptly and Carry the Task to Completion

MANY practicing and operating engineers maintain that they have no time to write for publication. Some admit that the initial effort, if not the entire task, is irksome. Very few realize that facility and achievement are the outcome of experience rather than of inherent or inherited skill.

Many credit success to genius instead of to hard work; they themselves disclaim the possession of what is commonly known as talent, and therein find solace for failure. "Ah! But he has a gift," is an oft-repeated saying to explain the success of the writer, the artist, the actor. The achievement appears spectacular to the layman, who fails to appreciate the self-denial and drudgery and attention to monotonous detail that build the foundation of successful achievement and ease of performance.

The influence of heredity is invariably over-emphasized. In many instances the opposite to what is expected occurs, the son showing no liking or ability to follow in his father's footsteps. A trait may skip one or more generations, to reappear later; but emulation usually plays an important part in the formation of character and in the choice of work. A boy whose father is a successful engineer appreciates the scope and limitations of such a profession; it is considered natural that he should do likewise; his choice is taken as a matter of course. His father, on the other hand, knows what should be avoided in the preliminary stages; his connections are such that the development of the son into a full-fledged engineer is facilitated. The boy is spurred to work harder and to take greater pains because of what is expected of him as the son of his father. He is better off than others who have no paternal help or influence; but it is emulation and hard work rather than heredity that influence the result.

These comments and reminiscences were prompted by an editorial statement in a recent issue of *The Forum* anent the capacity for work of one of its most brilliant contributors, Mr. T. Swann Harding, who published 110 articles in 1928 and confesses to reading an average of one book per day and to scanning over 100 scientific and general periodicals. If the career of such a man were ever analyzed, one would find that hard training, self-denial and continuous output, disregarding inevitable setbacks, bred facility; and that facility changed drudgery into pleasure. There is no other and shorter cut to successful achievement.

To the engineer who recognizes his obligation to add to the melting pot of knowledge by contributing his share of experiences and the results of his labors, no evasion of the task, however disinclined he may be to perform it, is possible without the loss of moral status. Not only must it be done promptly, but it must be done to completion. All successful men will admit the force of this truism. "Do it now" is a maxim that should be applied with special emphasis to the task, sometimes irksome but always essential to success, of becoming articulate to the world at large through the medium of the printed word.

Vibration as a Motive Force in Conveyance of Material

THE utilization of vibratory motion in ore dressing and metallurgical operations has been small, the most important application being in connection with screening and settling apparatus. Earlier types of mechanical screens were set at a steep angle, and it was not until this inclination was reduced that notice was attracted to the somewhat uncanny property developed by the oversize in its ability to travel uphill when under the influence of certain vibratory motion.

Success leads to close observation, which, in turn, leads to further development. And so it happens that the principle underlying the screening of an ore by vibration is now being applied and adapted to the conveyance of ore, with a new field of usefulness ahead in utilizing the basic idea in moving material from one place to another, or to effect the separation of a settling product from a non-settling one.

Apart from its ability to coax material against the pull of gravity, a vibration conveyor unit is self-contained, and so is particularly suitable for short hauls and feeder service. The electric motor supplying the vibration is a part of the conveyor, and the complete unit may be suspended without bottom or side support. Moreover, the rate of flow may be controlled by rheostatic manipulation. The vibratory conveyor lends itself to the solution of an unusual problem, such as the transfer of hot material, in which case the unit consists essentially of a suspended tube with vibratory motor attached.

A few years ago an attempt was made to apply vibration to the crushing of an ore. The idea was logical: A large number of small movements is preferable to a small number of large ones; but the strain on the electrical apparatus providing the power was apparently too severe. *Engineering and Mining Journal* suggested later that a vibration produced by fluctuating water motion—as in the Constantinesco rock drill—might prove suitable and practicable. Opportunity for invention would yet seem feasible in this connection, to produce a crusher that would utilize the impact force as well as the conveying and classifying effect of vibration.

Classification of Precious Stones by the Use of Cathode Rays

THE CATHODE-RAY TUBE, developed at the General Electric laboratories about three years ago by Dr. W. D. Coolidge, has been found useful for a score of purposes, the latest of which is in distinguishing natural stones from synthetic gems. In the design and manufacture of precision meters and other continuous-operation electrical instruments, the hardness of bearing surfaces is an important factor. More than one and a half million gems are used annually for this purpose by the company. In testing supplies, the stones are subjected to the cathode rays for a few seconds, after which the synthetic stones continue to be visible in the dark, whereas the natural stones are no longer luminous.

The degree to which the technique of sorting gems has been elaborated at Schenectady will prove of interest to readers of a scientific turn of mind—who appreciate how any laboratory development may prove of the greatest industrial importance. The rays from the new Coolidge tube are also used to determine the place of origin of the gems, natural or artificial. Thus is practicable the separation of sapphires from Australia and sapphires from Montana. With synthetic gems it is possible to determine the factory of origin by their reaction to the cathode rays. Research has also demonstrated that artificial diamonds turn brown when placed in the path of the rays, whereas the natural stone remains unaltered in appearance.

The results of research and experimentation proceed apace, despite an advance in the creative output of the human mind in the last fifty years that has exceeded the total inventive result of a dozen centuries. Invention has been found to lead to invention. The search grows keener with each new discovery. No one can logically predict a limit to the advances that may be made in the near future in achieving the seemingly impossible.

Discovery Was Ever a Solitary Task

SPEAKING at the annual convocation of the Graduate School of Brown University recently, Dr. Hans Zinsser sought to encourage individuality in initiative and invention, after urging that those with the privilege of appraisal, "instead of thinking the world is best served by a mass production of factory-made scholars, should shoulder the risk of error and humanely divert the palpable pre-doomed doctor of philosophy into the happier destinies of the drygoods business or encourage him to escape in time into a teacher's college or business school."

Of mass research Doctor Zinsser also used plain terms, averring that "Research councils and foundations organize co-operative researches, thinking that the timid game of truth can be snared by the noisy advance of well-drilled companies of technicians, forgetting that discovery was ever a solitary task in which co-operation must be spontaneous. . . . If these foundations engage in work of their own," he continued, "they are unqualified contributors to progress and scholarship. If they are merely a sort of super-hierarchy of benefactors, they become, unwittingly perhaps, arbiters of policy and purpose: Institutions vie for their favor and adjust to their opinions; and administrators, not scholars, negotiate for their support. . . . We are a mass-produced, newspapered, broadcasted, and prohibited generation. The administrative tail has elephantiasis, and the poor intellectual dog can hardly drag it along, let alone wag it. . . . The normal scholar—an incorrigible individualist—if he is worth his salt, will not be content to become a mere tenant. He will make his own the soil he cultivates."

The tendency is all too common to deflect opportunity for initiative and the reward for invention into the laps of the influential. If the "garret genius" cannot stifle the urge engendered by creative ability, he should seek employment in a research laboratory, one is told by administrative officials. The subsidized organization of this type would doubtless welcome the extinction of the lone inventor, who has to his credit most of the great achievements of the century. A corps of research men may accomplish much, but the world will always depend on the inquisitiveness of the individual and the zest of personal achievement. The very obstacles placed in the path of the discouraged inventor are as stepping stones to his ultimate success.

A Plea for Precision in Electrometallurgical Terminology

A FEW YEARS AGO an interesting paper was presented at a meeting of the American Electrochemical Society on electrolytic operations at Chuquicamata. Various features of technique and technology attracted deserved attention, but the contributed discussion also contained a protest and a plea that bore but little fruit. The title of the paper was given as "The Electrolytic Tank House, Chile Exploration Company, Chuquicamata, Chile," but the "house" in question was hardly mentioned, the article being almost entirely concerned with a description of electrochemical equipment and auxiliary apparatus, methods of operation, and results.

The opening paragraph read as follows:

"At present there are eight electrical tank circuits in the house. The number of tanks per circuit varies from 96 to 164. In all circuits the tanks are in series, and in all tanks the electrodes are in multiple. There are 894 tanks in the house. For the purpose of circulation, the tanks are arranged in sections; the standard section consisting of 16 tanks. A section is a cascade of tanks so placed that the outflow of one tank forms the inflow of the succeeding. The general direction of flow through each individual tank is perpendicular to the electrodes. The tanks are 18 ft. 8 in. by 3 ft. 5 in. and 5 ft. 10 in. deep inside dimensions. . . ."

The plea and the protest that followed were concerned with the unscientific and illogical use of the terms "tank house" and "tank," which are redolent of the slaughter house and the stockyard. The author made confusion worse confounded when he lacked another term to refer to a vessel for the storage of treated or untreated solution. The mental confusion resulting in the mind of the reader was heightened by the necessity

to learn that the outflow from a "tank" was spent electrolyte.

As has been pointed out, the electrometallurgy of copper is a comparatively new science, but that fact offers no justification for a selection of words that inhibits clarity of presentation and discourages precision in thinking and statement. *Engineering and Mining Journal* has a clear duty to endeavor to prevent future generations from being burdened with an inheritance of illogical precedent.

The term "tank house" is uninformative to the point of being misleading. It should be abandoned. No more need exists to feature "tank house" when referring to an electrometallurgical operation than to use a term such as "vat house" when discussing lixiviation or "furnace house" when speaking of smelting. A tank is a vessel for the storage of a liquid. A unit containing electrodes and an electrolyte is a "cell." If any of our electrometallurgical readers doubt that careful and suitable terminology makes for simplicity and clarity and precision, let them turn to the article on "The Sullivan Electrolytic Zinc Plant," By Mr. U. C. Tainton, published in *Engineering and Mining Journal* of Dec. 1, 1928.

The Relative Salary Question Crops Up Again

REPORTS of salaries received by professional and business men are always interesting news. They give the ultra-successful man opportunity to see how much better he has succeeded than the common herd, and they provide an alibi for the failure in most lines of human activity, for the data make it plain that many an individual has missed his calling.

Several years ago the summary of a study made by Cornell University was published in these columns, which showed bankers and brokers, with their self-evident opportunities, to be the most highly paid of all of those in the professional or business groups. Engineers came next to last, one step above teachers and one step below veterinarians. Now appears in the press the result of an investigation made by Mr. Edward S. Jones, of the University of Buffalo, who based his compilation on reports from 713 graduates of 70 colleges and universities in the United States and Canada. He found that the average annual income of the successful man of forty is about as follows:

Medicine	$9,500
Dentistry	8,000
Sales management	7,500
Insurance	6,900
General business executives	6,900
Advertising	6,750
Law	6,600
Banking	6,500
Research science	5,900
Civil and electrical engineering	5,500
Chemistry and chemical engineering	5,300
Mechanical engineering	5,200
Teaching	4,000
Ministry	3,500

The mining engineer, probably being hard to locate, is not mentioned, nor shall we venture an opinion as to where he should be placed. If he has ability and experience, attractive personality, and good luck he can probably look down on the average medico who sits on top of this list. If he lacks one or more of these qualities, his income may be no larger than that of the average teacher or minister. It is heartening to see that the scientific man engaged in research stands so respectably in this compilation; it is a belated recognition of the value of the services of one who is so often thoughtlessly considered as a non-producer.

Survey Lends Encouragement to Quicksilver Producers

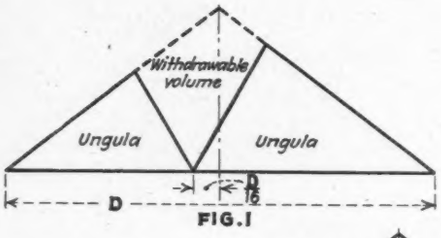
TREPIDATION has been evident occasionally among quicksilver producers in the United States that current price levels and the consequent stimulus to production may bring about the dual misfortune of the use of substitutes and a recession in prices. Undoubtedly, the practice of a producer to sell direct to a consumer, often employed in the quicksilver industry, and the absence of a trade association, with its usual stabilizing effect, have caused producers at times to be dubious concerning the future of the metal. Such interests, however, may find much of an encouraging nature in the report of a recent economic survey made by the Bureau of Mines that contains the first reliable data to be published as to the channels of consumption of the metal in the United States.

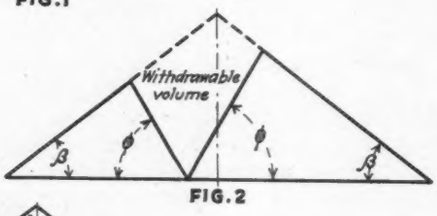
The most impressive fact the survey revealed was that a large portion of the total output of quicksilver is used in the manufacture of scientific and technical instruments—the result of a steadily increasing demand by modern industry for accurate and automatic control of methods and processes. Formerly, the utilization of the metal for amalgamation purposes furnished the largest demand, but this outlet is now of negligible domestic importance. Mercury fulminate continues to be used in blasting caps and ammunition, although many attempts have been made to find substitutes, particularly during periods of high prices. Pharmaceutical and chemical products, neon and mercury lights, pigments and cosmetics, and electrical apparatus provide increasing and steady outlets for the metal.

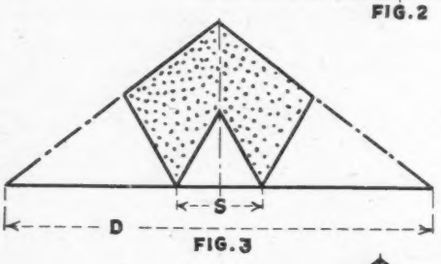
The mercury-vapor boiler may possibly provide the largest demand for quicksilver in the future. The transfer of heat by mercury is already practiced extensively in the processing industries, where accurate temperature control is required, and, as industry expands, wider application of such apparatus is inevitable. For power-generation purposes, the mercury-vapor boiler has not as yet emerged from the experimental stage, although since October, 1928, a 10,000-kw. turbine installation has been in commercial use at a Connecticut power plant. Practical operating experience obtained as a result of this installation, however, indicates that general utilization of such equipment is a possibility.

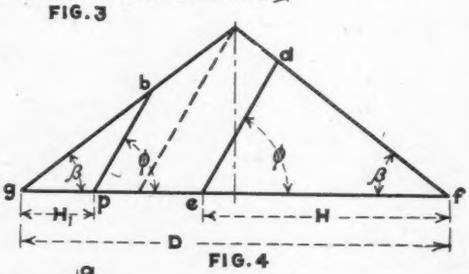
In summary, therefore, the development and expansion of modern industry is likely to have a favorable effect on the future of quicksilver. The outlook to the American producer of the metal may be fraught at times with doubts, but apparently the prospects for the years immediately ahead are bright. The large foreign producers are apparently not fearful that present relatively high prices will stimulate American production too much.

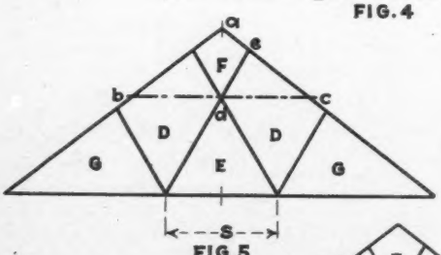
Storage of Ore in Stockpiles

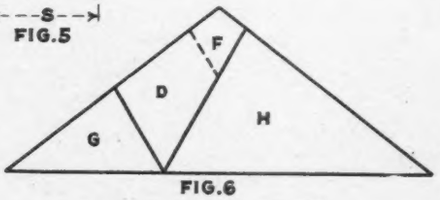












Diagrams showing formation and mathematical analysis of ungulas in conical stockpiles

WHEN a large tonnage of stored ore or other material is necessary at a reduction works or elsewhere, the use of a dump has advantages over a bin. For a large, easily withdrawable capacity, such as 1,500 tons or more, the cost of a bin with feeding and withdrawing equipment is greater than the cost of the feeder supports over the dump plus the chute tunnels under the dump. Steelwork for carrying the feeder for the dump may be more expensive than that required to feed a bin, particularly if the feeder belt to the dump has to be carried by a cantilever, as at West Springs mine, Transvaal, instead of the usual trussed girder required for a bin. The increased cost of the steelwork for the feeder belt, however, is more than offset by the saving on the bin walls. Another advantage of a storage dump is that any shortage is at once obvious to the eye, and hence the need for speeding up its replenishment is not likely to be overlooked.

A dump will be conical if fed from one point, and a long ridge-like dump will be formed if a shuttle belt or tripper is used. The withdrawable capacity of the latter type is easy to calculate, as the cross-section is a triangle, but the withdrawable volume obtainable from a conical dump is troublesome to evaluate. When a conical dump is drawn from by a row of chutes beneath it, some of the original dump will remain *in situ*, and this portion can be formed in "waste" material. The residual portions will be sections of a cone, known as ungulas (Latin, hoof-shaped), as shown in Fig. 1. Withdrawable capacity of the dump is the volume of the whole cone minus the two "permanent" ungulas. Design of a dump for a certain tonnage depends, therefore, on the correct estimation of the volumes of conical ungulas, a subject which is left severely alone in a book on conic sections in my possession.

One row of chutes will withdraw a V-shaped portion, as shown in Fig. 2. The angle of repose, ϕ, is another determinant of the tonnage available, and is the angle which most deserves this appellation, as it is a "static" angle. The angle at the base marked β is that produced by particles rolling down the face of the dump; it is not the true angle of repose. Angle β for Witwatersrand gold reef and for most "hard" ores of any kind is about $37\frac{1}{2}$ deg., whereas the angle ϕ, which is always greater than β, ranges from 45 to 60 deg. with the horizontal. Any conical dump can be divided into ungulas and smaller cones, even if two rows of chutes are used for withdrawing ore, as in Fig. 3, and if the volumes of ungulas are determined, the withdrawable capacity may be ascertained readily.

Although the value of β for hard ores is $37\frac{1}{2}$ deg., a

A Discussion of Theory and Practice

BY A. L. EGAN
Johannesburg, Transvaal

formula providing for variations in both β and ϕ will permit it to be applied to coal and other materials. The simplest formula is that by which the volume of an ungula is determined as a percentage of the whole cone of which it forms a part. Referring to Fig. 4, an ungula of the shape *d e f* will be termed a major ungula and one of the shape *b g p* a minor ungula. For major ungulas, H is measured from f, and for minor ungulas H_1 is measured from g. Let m be the ratio of H to D, or $\frac{H}{D}$. For this value of m, called "Height" or "Rise," find in tables of segment areas the tabular area of the corresponding circular segment. This area will be referred to here as A.

Then $$C = \frac{m}{1 + \frac{\cot \phi}{\cot \beta}}$$

And $$X = \frac{m}{2(1 - C)}$$

For the value X, read as "Height" or "Rise" in tables of segment areas, another tabular segment area is obtained, which will be referred to as a. Then the ratio of the ungula volume to that of the whole cone is given by the formula: $\frac{4C}{\pi}\left\{ A + 4a(1-C)^2 \right\}$ Equation (1).

In determining minor ungulas, the procedure is similar, but for these $n = \frac{H_1}{D}$, and $C = \frac{n}{1 - \frac{\cot \phi}{\cot \beta}}$

A, X, and a are ascertained in the same way as for major ungulas, and the volume ratio is determined by means of Equation (1). It should be noted that the point d in Fig. 4 coincides with the apex of the cone when $\frac{H}{D}$ is such that $m = \frac{1}{2}\left(1 + \frac{\cot \phi}{\cot \beta}\right)$, or when $\frac{H_1}{D}$ is such that $n = \frac{1}{2}\left(1 - \frac{\cot \phi}{\cot \beta}\right)$. These values define the limits of the direct use of Equation (1). For example, if the volume of the portion *b f p* is required, subtract the volume of the minor ungula *b g p* from the whole cone. To avoid numerical calculation in the case of hard-ore dumps having a base angle of $37\frac{1}{2}$ deg., curves are presented in Fig. 7 from which the percentage volumes of ungulas can be read for any value of ϕ, and for all values of $m = \frac{H}{D}$ up to $\frac{1}{1}$. n and H_1, however,

Steel cantilever carrying feeder belt at the West Springs mine, Johannesburg

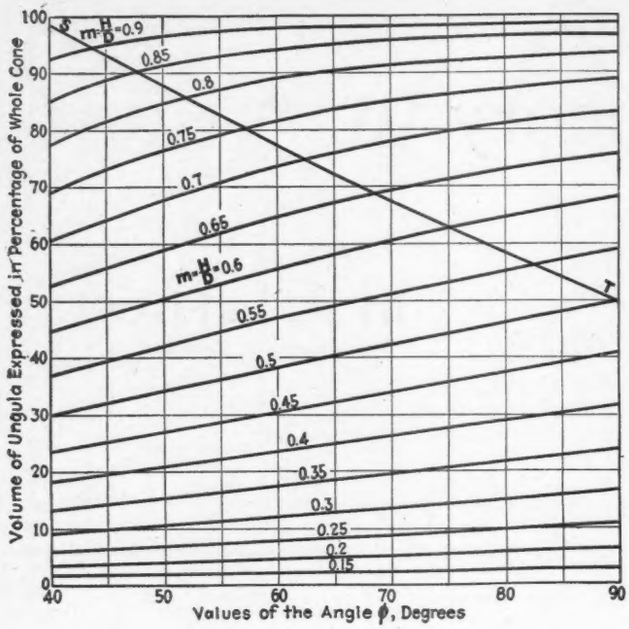


Chart for the determination of the volumes of ungulas formed in cones having base angles of 37½ deg.

are not considered in this diagram. Points on or below the line *S T* indicate that the volume is that a major ungula, whereas points above the line indicate that the volume is that of the whole cone minus a minor ungula.

Obviously, the maximum withdrawable tonnage is obtained from one row of chutes when the row passes under the center of the base. However, if the single row of chutes is not offset more than $\frac{D}{16}$ from the center (see Fig. 1), the reduction in obtainable tonnage does not exceed 1 per cent of the whole cone. When ore is withdrawn from two parallel rows of chutes, one each side of the center line (see Fig. 3), the maximum withdrawable percentage is obtained when the distance between the two rows of chutes (marked *s* in Fig. 3) is between 0.2 and 0.25 *D*.

In calculating the withdrawable volume from two rows of chutes, as indicated in Figs. 5 and 6, the capital letters on which indicate volumes, first determine *F* by subtracting two ungulas *e d c* from the smaller cone *a b c*. Next ascertain $(F + D)$ by subtracting ungulas *G* and *H* from the whole cone. Then the withdrawable volume is equal to $2\ (F+D) - F$.

The volume of *E* (Fig. 5) is useful, as it can be regarded as a reserve storage which can easily be shoveled into the chutes in an emergency. The volume of *E* is equal to $(F + 2H$ — the whole cone). If each chute tunnel is formed with an inverted "V" roof, the volume *E* will not exist, but, as the slope of the roofs can be less than ϕ, a little more withdrawable capacity can be obtained at the sacrifice of the "shoveling" reserve.

Production of Aluminum Increased in 1928

THE value of new aluminum produced in the United States during 1928 was $47,899,000, an increase of 22 per cent as compared with 1927, according to a statement of the U. S. Bureau of Mines. The principal producing plant was that at Massena, N. Y., where approximately 45 per cent of the metal made in the United States was recovered. Other works are at Niagara Falls, N. W.; Alcoa, Tenn.; and Badin (Whitney), N. C.

The domestic price of new aluminum ingot 99 per cent pure, as quoted by the *Engineering and Mining Journal*, was 24.3c. a pound during the entire year 1928. Prices of outside metal 98-99 per cent pure held throughout the year at 23.9c. a pound.

The record production of automobiles in 1928 and the wider adoption of aluminum pistons and connecting rods in the manufacture thereof combined to increase greatly the consumption of aluminum by the automotive industry in 1928. Aluminum furniture has come into a position of prominence rapidly, and many railroads have adopted aluminum chairs as standard equipment in their dining cars, and installations have also been made in offices and libraries. The use of aluminum in experimental work in railroad car construction and the equally prominent field of commercial truck body manufacture continued during the year. Utilization of aluminum bronze powder as a paint pigment, and of aluminum for screw machine parts, bottle caps, foil, and collapsible tubes showed a normal increase in consumption during 1928, and in the aircraft industry the rate of consumption of aluminum strong alloys is said to have trebled within the year.

Imports of aluminum metal, scrap, and alloy in 1928 were 48 per cent less in quantity than in 1927, and imports of hollow ware were 13 per cent less than in the previous year. Imports of plates, sheets, bars, and other forms in 1928 decreased 93 per cent in quantity, and "other manufactures" of aluminum decreased 11 per cent in value, as compared with imports of similar products in 1927.

Exports of aluminum ingots, scrap, and alloys in 1928 decreased 32 per cent in quantity and of tubes, moldings, castings, and other shapes decreased 34 per cent, as compared with 1927 but exports of plates, sheets, bars, and other forms increased 21 per cent.

A Technical Library at Small Cost

THE FOLLOWING is an abstract from a letter received from a South American recently by a New York firm:

> "We have a three years' accumulation of *Engineering and Mining Journal* at our plant and wish quotation on an economical and practical binder to hold these copies."

The inquiry was made of us as to whether or no we could furnish such a binder, and we were obliged to reply in the negative. But the engineer is a man of resourcefulness; and during our editorial travels we noticed how one subscriber has solved the problem of converting loose issues of Engineering and Mining Journal into neatly bound volumes, each with its index. The result is most satisfactory, the cost is negligible. A little craftsmanship is needed—that's all. The plan will be described in a forthcoming issue under the title "Getting the Most From a Subscription to Engineering and Mining Journal." Watch for it.

Valuation of California Limestones

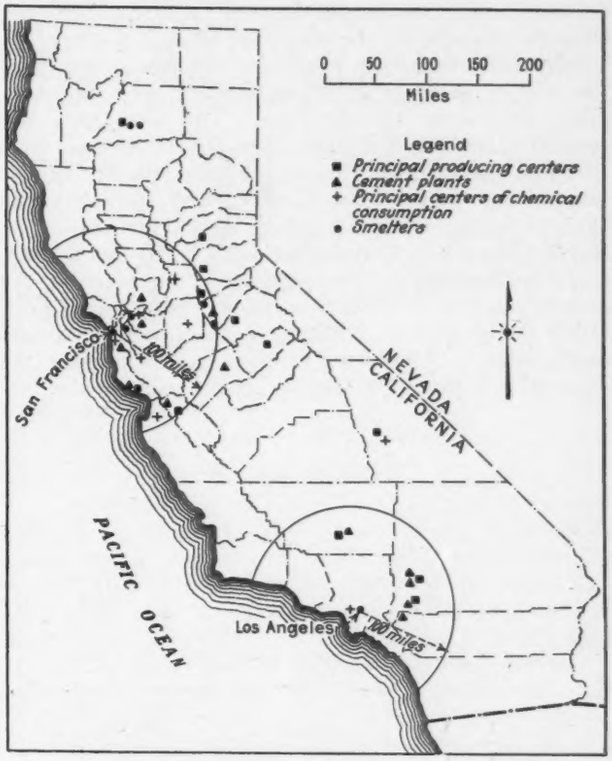
By James M. Hill
Geologist, Berkeley, Calif.

THE valuation of limestone deposits in California is so entirely different from the problem in the Eastern states that without a real knowledge of the relative scarcity of limestones in California the problems involved cannot be understood. Factors needing study in both East and West are the same—namely, chemical composition, physical character, amount available, relative scarcity, and location with respect to transportation routes, markets, and fuel and power. In the East relative scarcity hardly enters the valuation problem, but in California it is one of the most important factors to be considered. Location with respect to markets and transportation is probably the second most important factor in California. To add to the difficulties of valuation of the state's limestone deposits are their extreme irregularity of size, position with respect to mining, and chemical composition. Most of the deposits in California that are near markets are irregular lenticular bodies, which may vary from dolomite to limestone in relatively short distances, and which present many problems in mining that do not have to be considered by the more fortunate engineers who examine the extensive flat-lying, unmetamorphosed limestones of the Mississippi valley region and the similar beds of uptilted strata of the Appalachian Mountains.

In discussing limestone resources of California it seems best to divide the state into two parts, that north of Tehachipi and the desert, and that comprising the southern part of the state. This is done because freight rates play such an important part in the workability, or rather marketability, of limestone. From a close study of the situation it is clearly evident that, unless under exceptional conditions, limestone or limestone products cannot be transported more than 100 miles to consuming centers. It is also true that by far the greatest part of limestone products are shipped less than 50 miles to consumers. In discussing markets for crude limestone, the consuming industries should be considered first; these comprise the cement and building lime industry, agriculture, chemical industries, including sugar; and the metallurgical industries. Next, the consuming centers should be considered; these are state-wide for agriculture, and strictly limited for all of the other consuming industries, as shown on the accompanying sketch map.

Limestone for the cement industry is generally not transported more than a few miles as limestone, though in California there have been two notable exceptions to this procedure. The Pacific Portland Cement Company used crude limestone from a quarry near Auburn, Placer County, for its plant at Cement, near Suisun, Solano County, shipping a distance of approximately 85 miles at a freight rate of 80c. per ton. Yosemite Cement Company, whose plant is at Merced, uses limestone mined near El Portal, Mariposa County. The haul on crude rock is 63 miles and the freight rate approximately 1c. a ton-mile.

Builders' lime finds its chief market in the large



Sketch map of California showing the principal producing and consuming centers of the state's limestone industry

centers of population, and San Francisco Bay area, Sacramento, Stockton, Merced, Fresno, and Bakersfield, in the Great Valley, and the Los Angeles and San Diego areas, in the southern part of the state, are the large markets. The chief producing centers are the same as for agricultural lime, though the product sold to the building trades is burned lime and not ground limestone. The product is sold in paper bags, and in most instances cannot be shipped more than 100 miles at a profit to the producer.

Agricultural lime in crushed and ground form, and screened to various sizes, is sold in bulk, but usually it is sacked. It is used throughout the state, and frequently local limestone deposits are sources of supply, though the bulk of agricultural lime has come from the main producing centers. The radius of shipment from these centers has been limited in part by mining and grinding costs at each individual plant, but probably more by railroad rates. The principal producing points for agricultural lime are Kennett, Shasta County; Auburn, Placer County; Shingle Springs, Eldorado County; Ione, Amador County; Sonora, Tuolumne County; Felton and Santa Cruz, Santa Cruz County; Hollister and San Juan, San Benito County; Monterey and Salinas, Monterey County; Tehachipi, Kern County; and Colton, Oro Grande, and Victorville, San Bernardino County.

Limestone for the chemical industries, including the sugar refineries, is shipped crude in car lots. Generally, the sugar refineries are supplied from local deposits. The large chemical industries of the San Francisco Bay

area obtain limestone from the deposits in Placer, Santa Cruz, and San Benito counties. The Los Angeles industry is largely supplied by the limestone producers at Colton and Victorville, though some limestone and dolomite is shipped to Los Angeles from Tehachipi and from the deposits on the west side of Inyo County.

Only a few smelting plants are situated in the state. The copper smelters in Shasta County used local lime when they were in operation. The iron and steel industry about San Francisco Bay obtains its lime from Concord, Contra Costa County; Auburn, Placer County; Santa Cruz, Santa Cruz County; and Hollister, San Benito County. Copper-smelting plants formerly operated at Campo Seco and Copperopolis, Calaveras County, used local limestone. The smelters in the Los Angeles territory receive their supplies from Tehachipi, in Kern County, or from Victorville and Colton, in San Bernardino County. The few smelters in the desert are supplied with fluxing limestone from local deposits.

Distribution of Deposits

Larger deposits of limestone are situated in the desert counties of southern California than in any other part of the state, but owing to their distance from markets and the lack of cheap rail transportation, most of them have little or no commercial value. Deposits close to railroads and large consuming centers, as at Tehachipi, Kern County; and Oro Grande, Victorville, and Colton, in San Bernardino County, have been developed extensively and supply most of the requirements of California south of Tehachipi.

In the northern part of the state are a series of large and small lenticular bodies of limestone in the foothills of the Sierra, which have been utilized at various places, but have been extensively exploited only near rail transportation and within close proximity to markets, as at Sonora, Tuolumne County; Ione, Amador County; Shingle Springs, Eldorado County; and Auburn, Placer County. In the coast ranges there are also bodies of limestone, none of which, except those in Santa Clara and San Benito counties, have been worked to any great extent, owing to their distance from markets and the lack of transportation. In the northern counties are relatively large bodies of limestone which cannot possibly be considered of economic interest. The deposits near Pitt River, in Shasta County, are the only ones in the north end of the state which appear to have any promise of use in the near future.

Geology of Deposits in Northern California

In the northern part of the state the larger and more important limestone deposits are of the Paleozoic age. In the coast ranges all of the important limestone bodies are in the Pre-Franciscan formation, which has been intruded by granitic rocks. In the Sierra Nevada foothill belt and the Klamath and Siskiyou mountains the limestone occurs as large and small lenses in the Calaveras formation or its equivalent. The limestones of this age are nearly all crystalline as a result of metamorphism, though here and there fossiliferous limestones are found. Rocks of the coast ranges are largely pure calcium carbonate marbles, except near Hollister, in San Benito County, where dolomite is also found. Considerable dolomite prevails in the Sierra Nevada belt, and, in the absence of adequate chemical analyses, no deposit can be said to be pure calcium carbonate rock. In the largest body of this area, in Calaveras and Tuolumne counties, which has been worked extensively for lime and marble near Columbia and Sonora, is every gradation between dolomite and marble, all within a short distance. As a consequence mining of limestone in this area is carried on with close chemical supervision.

In the Jurassic Franciscan formation of the coast ranges, in northern California, are some lenticular bodies of dense, fine-grained, hard, and often siliceous limestones. Some of these bodies have been worked for local use, but, in general, they are neither of sufficient size nor of chemical purity to be of much economic importance. Limestones of this character have been mined near Cupertino and Los Gatos, Santa Clara County. The Tertiary formations of northern California are composed chiefly of sandstones and shales, but in some places are small bodies of calcareous shale or limestone, particularly near the base of the Monterey formation. These bodies are not large, usually are not pure, and have little economic value except for local use.

At several places in Contra Costa, Solano, and Napa counties, travertine bodies have been deposited by springs near irruptive rocks. These limestones are of recent age and cover fairly large areas, but are relatively thin and have not proved satisfactory sources of limestone for cement plants situated near Napa Junction and Suisun. Deposits near Concord, Contra Costa County, are apparently the largest of this type. Oyster and clam shell marls at the south end of San Francisco Bay have been dredged for shell, which is adaptable for agricultural use and cement manufacture.

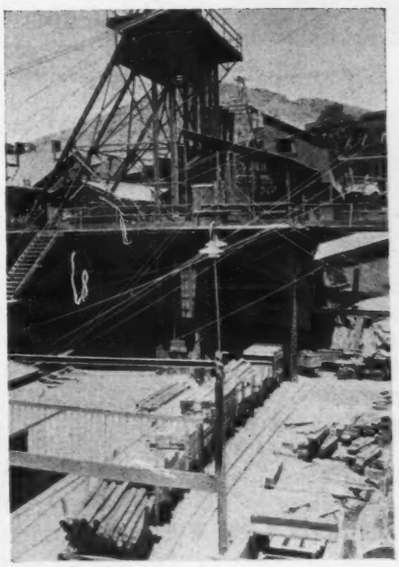
Deposits in Southern California

Much of southern California is known geologically only as a result of reconnaissance, but sufficient is known to warrant the statement that most of the limestone deposits of this region are of the Paleozoic age. There may be some Pre-Cambrian limestone in the eastern mountains, but that is not certain. Thick and extensive beds of dolomite and limestone are known in the White and Inyo range, the Slate range, and Panamint, Armagosa, and Kingston ranges, in Inyo County. In the shorter ranges of San Bernadino, Riverside, Imperial, and eastern San Diego counties there is also much limestone. This limestone in many instances has been metamorphosed to marble by igneous intrusive rocks, and some has been dolomitized. With the exception of the deposits near Owenyo, Keeler, and Trona, in Inyo County, and Oro Grande, Victorville, and Colton, in San Bernardino County, these limestones have had scant attention, because of their distance from transportation and markets. In the places where they have been worked, the deposits have been found to be broken and faulted, the rock being either fine or coarsely crystalline and of every degree of chemical composition from dolomite to limestone.

In the San Diego Mountains are some small bodies of limestone similar in occurrence and association to those of the foothill belt of the Sierra Nevada and Coast ranges in northern California. Most of these deposits have had little or no exploitation, except for local use. Along the coast in San Luis Obispo, Santa Barbara, Los Angeles, and Orange counties, large accumulations of oyster and clam shell on raised beaches or terraces are found at a few places. These have been a source of lime for local use at Capistrano, San Fernando, and Santa Margarita.

NOTES *on* ARIZONA COPPER MINING PROGRESS

By GEORGE J. YOUNG
Associate Editor



Working shaft at Old Dominion mine

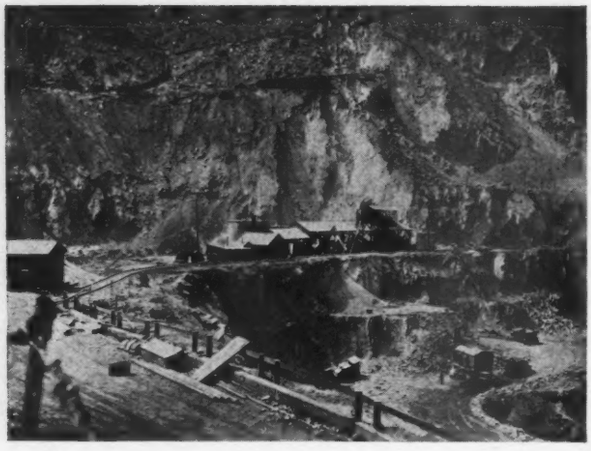
MANY automobiles are to be seen at the Jerome, Superior, Ray, Miami, Inspiration, and Globe camps, which I visited in May. Higher copper prices, with the consequent higher wages, have increased local purchasing power, and a "sunkist" region, together with the limited horizon of mining camps, has conspired to favor the auto salesman, and indirectly the copper-mining industry. The more automobiles there are, the more copper and other metals are needed. Arizona has a budget for 1929-30 involving an expenditure for road-building of over $800,000 in state funds, $1,991,842 in federal funds, and $58,174 in other funds, or a total of more than $2,850,000. It is thus indirectly contributing to the prosperity of the copper industry.

The copper districts visited are, of course, active and prosperous. Probably the most significant general movement is installation of additional power-generating facilities, for it is being realized that the hydro-electric output of the Roosevelt dam is quite uncertain. A new 18,000-kw. steam power plant is planned for Phoenix; Miami, Magma, and Inspiration are extending their steam power plants, and at the Old Dominion additional Diesel power is to be provided. Curtailment of production is also under way at some of the properties, notably at Ray and at Inspiration, but the effect of curtailment on mining communities will not be marked for some time.

At Jerome, United Verde is constructing a new hoist chamber underground for No. 5 shaft, the plans calling for an extension of hoisting depth to 4,250 ft. or about the 5,000 level of the mine. The hoist is to be a double-drum Nordberg, direct-connected to a 2,700-hp. d.c. motor, receiving its current from a motor-flywheel-generator set of 2,800 hp. Skip weight is 7 tons and ore load 7.8 tons. No. 5 shaft is used exclusively for ore hoisting. In excavating the chamber and connecting passages, a Butler shovel is in use for loading. The underground installation involves a special problem in ventilation. Final details are now being worked out in the engineering department. At No. 6 shaft, used for men and materials, another underground shaft and hoist are planned for service at greater depth than 3,000 ft. Underground stoping is on the 2,400 level and above, and shaft depth is 3,000 ft. Concrete and steel are in use in shaft support and underground chambers.

Present mine production is from 5,000 to 5,500 tons per day, of which about 3,000 tons is from open-pit operation. Mining methods have not changed greatly, but shrinkage stoping is being used less and horizontal cut-and-fill are being adopted to a greater extent. As an example, in 1928 the underground ore product was mined by the following methods, figures representing percentage: 17.2, square set; 3.4, incline square set; 18.8, top slice; 1, shrinkage; 5.5, incline cut and fill; 54, horizontal cut and fill; and 0.1, underhand stoping. Open-pit operations have been standardized on the basis of bench mining in 30-ft. lifts. Churn drills and power shovels are electrically operated. Transportation is by Linn tractor trucks, used under wet-weather conditions, and six-wheel Moreland trucks, which are standard for the pit. The transportation distance is small, as the pit is served by a number of transfers, close to the ore zone. Monthly output is about 90,000 tons of ore and from 100,000 to 105,000 tons of waste rock. The open-pit unit functions under its own organization and meets the smelter requirements by a well-worked-out system of selective mining. The flexibility of the mining equipment enables eight different classes of ore to be mined.

Many interesting operating problems arise in a mine as large as the United Verde. W. V. De Camp, general superintendent, discussed some of the important work now engaging the attention of the organization. Late in 1928, an underground fire brought out the need for extensive preparations to guard against recurrence of the disaster and to provide facilities for fire fighting. It is now planned to established a fire break at the 1,950 level by leaving a horizontal pillar 35 ft. in thickness, thus dividing the lower part of the mine from the upper. The ventilating system has been improved and a 100,000-gal. sump placed on the 1,000 level to protect



Slime preparation plant at the United Verde open pit

the lower part of the mine, which will be served by a 4-in. column with branches at each level. Interconnections with fresh-water and compressed-air lines have been made, and a 150-gal. pump has been placed on the 1,000 level to supply tanks on the side hill which serve the upper part of the mine. A slime plant equipped with 18x24-in. Blake crusher, 54x24-in. rolls, and 36-in.x8-ft. Hardinge ball mill, together with bins, has been erected on the operating level of the open pit. It supplies fifteen tons per hour, 55 per cent solids, of which 35 per cent passes through a 150 screen. A mill hole with bulldozing chamber on the south side of the pit supplies rock for the plant. Slime is delivered to the mine through a 4-in. column with 3-in. branches. In the upper, or old, fire zone of the mine it is forced into the stopes through the concrete bulkheads or through 2½-in. diamond-drill holes. About 10,000 tons of solids has already been used, and the present program will be extended over a period of several years before temperature is reduced sufficiently to permit underground mining in this zone. Standardized hose fittings for compressed-air and fire hose have been provided, steel fire doors have been placed, and fire-fighting and fire-prevention organizations have been established.

Mr. De Camp has also planned a sampling plant for more accurate sampling of mine products. Investigation of the advantages of more selective mining and of waste-rock elimination is in progress. A timber treatment unit, designed after Miami Copper's plant, has been installed. The treated timber will be used in the mine where long service is expected. Greater specialization in the mine personnel has been attained. Under Oscar Glaeser, safety superintendent, greater attention is being given to safety work: protective devices such as hard-toed shoes, hard hats, spats to protect the instep, and various types of goggles for eye protection are in common use. Electric blasting is being used more extensively. All development work and blasting in gaseous ground is now done with electric blasting caps. Oxygen helmet work has been intensified. Equipment is provided for eight five-men teams. The entire engineering staff has been enrolled in this work, and in addition eight teams are organized as a reserve. Trolley-wire operation is now restricted to five levels, a greater use being made of storage-battery locomotives.

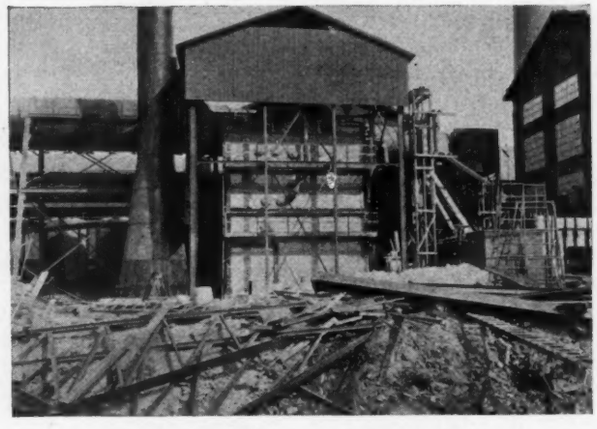
At Clarkdale, the most significant advance is the new research laboratory and its personnel. Under Oliver C. Ralston a campaign of investigation work in flotation and smelting is in progress. A substantial increase in milling plant capacity over the present 1,200 tons per day is indicated for the near future. This will mean narrowing of smelter work and more definite specialization. An electrolytic zinc plant may be constructed when the program for mining and treating zinc-copper ores is initiated.

Verde Central in Production

The Verde Central property, a few miles southwest of Jerome, is now in production. This interesting property is south of the United Verde and has been under development for many years. W. F. Stauton first directed exploration, having a keen faith in its possibilities. Calumet & Arizona took over an interest in Verde Central and supplied additional funds for exploration. Under R. H. Dickson, the ore showings have been developed, until systematic mining is now in progress. A 300-ton flotation mill was placed in operation early in the year, concentrates from which are being shipped regularly to the United Verde Extension smelter at Clemenceau. Minor changes in both mill and mine plant are being made.

Magma Increases Power Plant

At the Magma property, in the Superior district, new construction is under way at the smelter power house. A new 750-hp. Stirling boiler has been completed for



Boiler and power-plant construction at Magma Copper's smelter, Superior, Ariz.

operation at 225-lb. pressure and 100-deg. superheat. The boiler is given a high setting designed for a 200 per cent rating. A new 3,000-kw. Westinghouse steam turbine and generator are to be installed. Foundation work has been completed and steel for the power house is being erected. With the waste-heat and other boilers, Magma now satisfies its own power requirements. An Ingersoll-Rand turbo-blower of 10,000 cu.ft. capacity will also be installed to supplement the present blowing engine. A new flue has been constructed between the stack and the roasters.

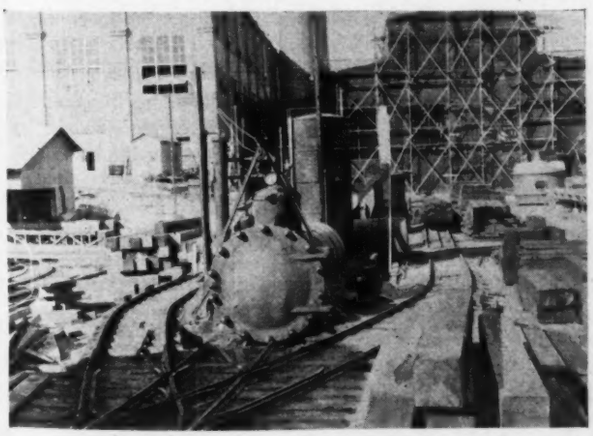
During the last five years Magma has produced about 250,000 tons of ore per year. The ratio of concentration in milling has been between 2½ and 3 to 1. Annual smelting tonnage is 125,000 tons, but in the last year it has increased to 180,000 tons. About 2,000 tons of custom ore is handled each month. The mill treats 800 tons of about 7 per cent copper ore daily. J. C. McNabb, in charge of milling operations, stated that no effort is being made to drop pyrite, as the iron is needed in the smelting plant. Aërofloat No. 25 to the amount of 0.18

lb. per ton and pine oil, 0.03 lb. per ton, are giving a 98.3 per cent extraction, with 0.19 to 0.20 per cent copper in the tailing. Both gold and silver recovery is high. This is remarkably good work. A 4-ft. Symons cone crusher has been installed in place of two 24-in. Symons disk crushers, and coarse crushing time has been reduced from twelve to eight hours, 97 per cent of the coarse product passing a $\frac{7}{8}$-in. screen. Ball consumption is about 3 lb. per ton. Grinding for flotation is 5 per cent on 65 screen. The mill crew comprises 41 men. Power consumption is 20 kw.-hr. per ton.

Commenting on conditions in the mine, William Koerner, general manager, stated that concreting the working shafts and extending the major development have progressed rapidly. No. 2 shaft has been concreted from the top to the 2,650 level and sinking is to be continued from the 2,800 level to the 3,000. No. 4 shaft, an upcast, has been enlarged by one compartment from the 650 to 1,000 level and this compartment is now being concreted. No. 3, the main working shaft, is timbered except for the lowest 300 ft., which is concreted. Officials expect that No. 2 shaft will be in operation and concreted to the 3,000 level by the end of the year. Development work is under way in No. 5 shaft. Preparations are being made to sink No. 6 shaft to the east, and drifting is in progress toward the position of this shaft. The total longitudinal extent of the mine workings is about 6,500 ft. A new level is developed each year, and major development is kept two or three years in advance. No changes have been made in mining methods. Butler shovels drive 8x8-ft. drifts and perform sill work. In an 8x8-ft. drift one of these machines mucks out 20 to 25 cars, or 60 tons, in one-half shift.

"Development and ventilation are our most important problems," commented Mr. Koerner. All shaft compartments have been standardized upon 4x5-ft. cross-section. At the foot of the No. 5 shaft a 90,000-cu.ft. Jeffery fan has been installed. On No. 4 shaft at No. 5 level a 150,000-cu.ft. fan is in operation, and at No. 2 and No. 3 levels, 30,000-cu.ft. fans are provided. Liberal application of concrete fireproofs the important shafts. Fire-fighting preparations have been effected. Of the present mine production of 22,000 tons per month, about 15 per cent is sent to the smelter and the remainder to the mill. The average assay of ore for 1928 was $7\frac{1}{2}$ per cent copper. Zinc-ore reserves are not mined, but No. 6 shaft is planned to open this section of the mine.

Construction at Miami. In background is the completion of the extension to boiler house. In foreground is timber treatment plant.



Tailing dam construction by Dorr classifiers at mill of Old Dominion mine

Ray is a well-ordered mining town. Few changes have taken place at the mine plant in recent months. Present production is about 11,000 tons daily. Greatest progress has been made underground, where a new mining method has been worked out, with decided improvements in operating costs and convenience in mining. R. W. Thomas, mine superintendent, said, "We are proud of our mining record." He stated that the new practice was an outgrowth of methods in use at Morenci and possessed the advantage of providing adequate ventilation in the working places. Heavy self-rotating stopers were tried out, but were found to be not so satisfactory as the lighter machines, which are preferred by the miners. Drilling is no problem at Ray. During 1928, underground mining cost was 68.83c. per ton.

Miami Completing Construction Program

Miami is producing about 13,000 tons of ore daily with a construction program in effect by which output will be increased to 18,000 tons daily. Miami began operations in 1911 at the rate of 2,500 tons per day. Among the changes is the installation in the coarse-crushing plant of two 7-ft. Symons cone crushers, one of which is now in operation. The Newhouse crusher is being used. New manganese apron plate feeders have been installed to supply the crushers. A dust system consisting of a suction fan and spray chamber gives about as efficient results as can be expected. It does not seem possible entirely to remove the dust, but the nuisance is largely mitigated.

In the mill six sections and an extension to the mill building are being completed. Grinding is being done in three stages. Each section contains the following: two Hardinge ball mills, which receive the feed and discharge into two Dorr classifiers; two Hardinge mills in closed circuit with two Dorr classifiers, to which the oversize is laundered; a 28-ft. bowl classifier, which receives the overflows; and a Williamson mill in closed circuit with the bowl classifier, to which is delivered the oversize product. About 50 per cent is minus 200 mesh and 5.1 per cent remains on 48 mesh. The overflow product of a fine-grinding section is 3,000 tons, with 27.6 per cent solids in the overflow discharge to the flotation division. A single 100-ft. rougher cell receives the pulp flow. Flotation concentrate from the head end is delivered to a 15-ft. cleaner cell, the remaining flotation concentrate as well as the cleaner reject being returned by Wilfley pumps to the rougher. The cleaner concentrate is reground

and by a similar flotation treatment brought to a concentrate of 40 per cent grade. In the re-treatment pyrite is rejected. Great credit is due Harry Hunt, metallurgist, for his re-treatment method, which is an important economic factor.

Rougher tailings from the Miami mill have been brought down to about 0.18 per cent copper, of which 0.06 per cent is sulphide copper. Heads are 0.86 per cent copper, oxide copper being 0.10 per cent. Copper extraction is over 86 per cent and concentration ratio about 25 to 1. This is an exceptional record. The new mill promises to influence practice to a considerable degree.

Tailing disposal at Miami has been thoroughly revised until the present plant represents good work in engineering design. Tailing, about 32 per cent solids, is taken in an open metal flume on an 0.8 per cent grade to a 325-ft. diameter Dorr thickener making one revolution in 45 minutes. The thickener is 3 ft. deep at the edges and 30 ft. at the center. In the overflow about 2,200 g.p.m. is reclaimed. Four 10-in. draw-off pipes carry the underflow (50 per cent solids) to a pumping station equipped with six Wilfley pumps operated by Texrope drives and 150-hp. motors. One 8-in. and two 6-in. Wilfley pumps carry the load, the remaining pumps being in reserve. The tailing is pumped into an air trap tank and pressure equalizer, and then into a pipe line, 3 miles long, to a new dump, which will probably provide storage for many years.

Mining practice has been changed only in minor details. An additional motor is to be added to the ore hoist, and Lilly controls are to be provided. Another motor-flywheel-generator unit has been installed. Ventilation, fire inspection, and safety practices have been highly developed. No. 5 shaft is being deepened and supported with creosoted timber in the new section. A 4-in. pipe line leads from the surface to the timbered section, where four 2-in. pipes connect with perforated rings placed at intervals in the shaft for fire protection.

At the power plant, four Heine VX type boilers, rated at 720 hp. and designed for 250 per cent over-rating, are being installed. Steam pressure is 425 lb. and superheat 200 deg. The old boilers are to be kept in reserve, as it is planned to carry the power load on the new boilers. A 14,600-kva. steam turbine-generator unit is being installed. This is in addition to two 4,000-kw. steam turbine-generator units, which have been sufficient for the power load until recently. Power generation will be 13,000 to 14,000 kw. at an expected power factor of 96 to 97 per cent. The line voltage is 6,600.

Compressed air is supplied by an 8,000-cu.ft. steam-driven compressor and an 8,000-cu.ft. synchronous motor-driven compressor. The compressed air requirement is 7,500,000 cu.ft. per day at 90-lb. pressure.

Inspiration Improves Leaching Practice

Inspiration has cut its copper production from 12,000,000 to 9,000,000 lb. per month. Improvements have been made in mining practice, so that the grade of ore has been increased 15 per cent and mining costs have been reduced despite 20 per cent increase in miners' wages. It is expected that when underground improvements have been completely introduced, an increase of 50 per cent will be made in production per man underground.

At the leaching plant, experiments in washing out slime from the crushed ore going to the leaching tanks have been completed, and consistent results in leaching have been obtained. Dorr classifiers are used and the slime washings are piped to the concentrating mill, where sulphide copper is recovered by flotation, the oxide slime tailing being stored. An acid-countercurrent decantation plant is being planned for the treatment of this material. This metallurgical work at Inspiration is of considerable interest in that it has proved the efficacy of delivering a deslimed product to leaching tanks, and has solved a difficulty which has probably heretofore been present in bulk leaching of crushed ores. The cyanider recognized this difficulty, and separated his pulps into sand and slime, providing separate treatment for each.

Inspiration has installed a 5½x22-ft. retort for treating timber with zinc chloride. At its boiler plant it is increasing boiler capacity by forced draft and by the addition of a 1,200-hp. B. & W. boiler. Boiler furnace design is improved and condenser capacity is increased by the addition of another cooling tower. At present three seam turbine units of 6,000 kw. and one 7,500-kw. unit carry a combined load of 28,000 kw. at an 80 per cent load factor.

Old Dominion Exploring

An active exploration campaign is under way at the Old Dominion property, at Globe. Present production is about 1,400 tons daily, of which 90 per cent is milled. Practically no changes have been made in the surface plant, except that additional Diesel power is to be installed. The deepest mine level is the 2,600. In developing the lower levels a churn-drill hole was extended from the 2,200 level to the 2,850, and has proved of considerable assistance in ventilation. The hole, which was started at 17½-in. diameter, remained vertical to the 2,400 level, but between the 2,400 and 2,600 levels it departed from the vertical 24 ft. A connection was made with it on the 2,600 level, as a result of the fortunate observation of one of the miners, who detected a weakness in the wall of the working.

The Old Dominion mine is pumping about 3,500,000 g.p.d. and is supplying Miami Copper with part of its water requirements, as well as the city of Globe. This is unusual for a mine confronted with a large underground water flow.

Beneficiation of Southwestern Manganese Ores May Be Practicable

EXPERIMENTAL work conducted at the Mississippi Valley Station of the U. S. Bureau of Mines, at Rolla, Mo., in co-operation with the Missouri School of Mines and Metallurgy, has indicated that certain low-grade manganese ores from the southwestern states, notably New Mexico, can be concentrated into merchantable products. All of the ores examined from this section are characterized by their low phosphorus content, and many of them contain siliceous gangue that can be rejected by jigging and tabling.

Numerous deposits of manganese ores occur in the southwestern states, but as yet only a few of them have been studied as to their amenability to concentration. It is essential that these deposits be given careful consideration, for though it might be uneconomical to mine and mill some of them under present market prices, they would constitute an important reserve that could be drawn on during an emergency or in periods of national necessity.

Scientific Management in Mining

Abstract From the Address of the Retiring President of the Institution of Mining and Metallurgy, Prof. S. J. Truscott, Delivered at the Thirty-eighth Annual Meeting

MINING in the sense here to be employed is the industry which wrests the material of mineral deposits from the earth's rocky crust and delivers it at the surface. To do this, a large labor force is usually required, much machinery, and consequently an efficient management. In these requirements, mining resembles any ordinary producing industry. It is, moreover, subject to all the hazards of producing industries: variations in demand for its products, competition within itself, competition with substitutes produced by other industries, variations in the prices of labor and of essential materials.

The need for efficient management may indeed be said to be greater in mining than with ordinary producing industries, because penetration below the surface renders the enterprise liable to special hazards, such as collapse of ground or inundation by water, which have to be specially guarded against and which cause considerable derangement of the work. Mining also involves the making of costly roads and works beneath the surface before production can begin, yet which, when production is finished, have no value as assets. To wrest the mineral from its rocky seat, to break up its solidity that it may be removed, and to raise it to the surface, are operations requiring the expenditure of great energy and the exercise of great power—greater than with ordinary manufacturing industries. In mining, roughly 500 hp. is installed for every 100 persons engaged, whereas in ordinary manufacturing enterprises about 150 hp. suffices. To make the roads, to construct the necessary works, and to provide the necessary mechanical equipment, a large expenditure must be risked in the enterprise. With mining, this necessary capital is not uncommonly as much as or more than the value of the annual output, and generally is at least a large fraction of that value; whereas with ordinary manufacturing industries that expenditure is generally but a small fraction, sometimes less than 5 per cent, of the value of the annual output.

In mining, also, the expenditure on labor is high, representing generally between 50 and 70 per cent of the total operating cost of production, the balance being expenditure on materials, power, and the general expenses of administration.

It goes without saying that in such an industry, conducted generally underground, and with operations often spread over a large area, waste of money, men, materials, and machines will exist. It will equally not be disputed that management will be directly responsible for most of this waste. It is well to have figures, and in this matter, as the result of a widely circulated questionnaire, a committee of the Federated American Engineering Societies reporting on the "Elimination of Waste in Industry" stated that management was directly responsible for from 50 to 80 per cent of the waste in industry. From the considerations mentioned above it is likely that in mining the proportion will be higher rather than lower.

By management is meant the whole directing organization, directors and business manager, consulting engineer, and mine manager. The waste caused by bad finance, indecision, and conservatism falls upon the directors; that chargeable to inefficient purchase of materials and unbusinesslike sale of products falls upon the business manager; upon the consulting engineer and mine manager falls the responsibility for the waste that results by reason of bad layout of the works, bad coordination of operations, and improper selection and application of men, materials, and machines.

Nowadays, however, even if only to meet competition, economy in production demands the elimination of all avoidable waste; and industries, including the mining industry, are gradually adjusting themselves thereto by organizing their management on bases laid bare by the collection and analysis of coldly ascertained facts. Management so based has been termed scientific management, to distinguish it from the empirical management of the past, which was based largely on preconceived ideas held by the practical man. Under it, responsibility is withdrawn from the shoulders of those who carry out work, and placed upon those who direct the work, where it more rightly belongs. Although these principles are applicable to management as a whole—that is, equally to the financial, commercial, and technical branches—they are more particularly effective in their application to the last. Moreover, the financial and commercial applications are common to all industries, whereas the technical applications vary with the particular industry, in this instance that of mining. Accordingly, only these last will here receive attention.

Technical management under this régime falls naturally into two branches: first, that which ascertains facts, makes tests, digests data, works out standard performances, and thinks out plans which shall result in economy; this branch may be termed that of *efficiency engineering*. Second, a branch which, given a detailed plan to follow and a standard of performance at which to aim, is charged with the endeavor to attain the budgeted results —this branch is that of *supervision*.

With economy in view, the most complete—indeed, the

only complete—expression of the facts is in terms of money. It is, for instance, an incomplete statement of the position to say that a machine has replaced ten men. The whole cost of machine working, investment cost as well as operating cost, must be made available for comparison with that of manual working.

An appropriate system of *bookkeeping* plays therefore a not unimportant part. In such a system each self-contained operation or working place will have a separate account, and the endeavor will be to divide the work into such operations as are usually kept separate in mining, so that comparison between the costs on other mines is thereby possible. In other words, the techical necessities should determine the detailed bookkeeping, a practice which is facilitated by the data given in the technical statistical reports.

Efficiency Engineering

Factors Bearing on Economy—The facts to be ascertained are: first, those which obtain under the present procedure; and, second, those which, being in the nature of research, may disclose fresh possibilities of economy, particularly in the means employed.

The ascertainment of the detailed facts under the present procedure will disclose opportunities for economy. In each division or operation into which the work may be divided there are, broadly speaking, two ways in which economy may possibly be effected—by decreasing the number of units of work to be done, and by decreasing the cost per unit of work. In haulage, for instance, the number of ton-miles may be decreased by shortening the length of the road, and the cost per ton-mile may be decreased by improved methods of haulage. Similarly, in respect to development, the cost of this preparatory work may be decreased by spacing the development roads at wider intervals and thus shortening their total length, and the cost per unit of length may be decreased by more rational methods and more suitable machines.

Carrying the analysis a step further, the first possibility is largely a question of the mine layout, and may therefore be described as the *layout factor*. The second possibility, although obviously dependent on the proper application of labor, materials, and equipment, depends also to a large extent on the co-ordination of the work—on the full use of the allotted means. The cost per unit of haulage will, for instance, increase if the labor and equipment allotted to it are standing idle a good part of the time, awaiting the arrival of work. Similarly, the cost of winning will increase if the miner is held up because the trammer has not got the broken rock away. The factor expressing the degree of use to which the means is put or employed may be described as the *load factor*, borrowing an expression usual in power transmission. Finally, the proper application of these means—that is, the proper and efficient application of labor materials, and machinery to the work—may be termed the *mechanical factor*.

Investigation of the present procedure with respect to these three factors may be made as follows: The economy of the layout may be tested by the mine plans; that of the load, by special statistics and analyses known as time studies; that of the means may be tested by technical tests, which may be described as mechanical studies.

Time Studies—Time studies consist of comprehensive observations on routine work, in which the timing of definite occupations during that work plays an essential and preponderating part. They serve to disclose the relative importance of these occupations, and particularly the relation between the idle and the working portions. Making note of all the conditions, natural and working, they furnish at the same time some idea of the suitability of the labor, materials, and machines for the particular work. Finally, they provide bases on which standards of performance can be set up, and from which schemes for improved economy can be projected.

Table I—Observation Sheet

Time Study .....No. ..... Date .....

Equipment .....Observer .....

Conditions .....

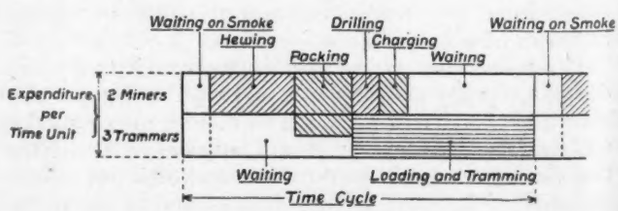
Times*	Individual men forming a working group, or machines.								
Hr. Min.									

*For each man, when different occupations begin.

Time studies may be laid out either to investigate the co-ordination of different occupations within the same supervisory unit, as, for instance, a working place; or they may be laid out to disclose the particular efficiency of a technical operation, such as drilling or tramming. Seeing, however, that labor is the greatest item in the cost of mining, and that the proper co-ordination of labor—that is, its load factor—is more vital in the complex work of mining than the mechanical efficiency of labor in purely physical tasks—that is, its mechanical factor—the first procedure is the more useful, though both are employed.

Following the more useful of these two lines, and making accordingly a time study of a supervisory unit, say, of a group of men, observations are made of the times these men severally change their occupations. These times are recorded on *field* or *observation sheets* ruled with vertical columns, one for each man, and with horizontal lines on which to record the times when one man or all of the men changed occupation, the new occupation being entered in the appropriate column or columns, generally by a symbol or letter. On these lines the shift runs down the sheet (Table I). A variant sometimes used is to let the shift run horizontally, the men's names being placed one under another in the left-hand vertical column. Sometimes also the individual minutes of the complete shift have place upon the sheet. Whatever the form of these observation sheets, the conditions of the ground and of the work are noted upon it, and the equipment likewise is specified.

Fig. 1—Consolidation chart



In the office these field observations are segregated on *summary sheets,* which permit the periods spent in particular occupations to be brought to totals and averages, and the relations between the different useful occupations, as well as the relation between the total useful occupation and the total of the idle periods, to be disclosed (Table II), this latter relation being, of course, the load factor.

When several complete observations of the same study have been made, the whole of the results may be usefully summarized a step further on a *consolidation sheet,* in which money columns are provided so that the cost of avoidable idleness may be made apparent, and the direction toward better co-ordination of the work may be indicated. Plotted graphically these consolidated figures make a *consolidation chart,* by which any lack of co-ordination becomes so strikingly displayed as to be inescapable, even to those who hesitate to accept or cannot understand figures (Fig. 1).

With different classes of men working together in one group, the co-ordination or lack of co-ordination between the different men determines the load factor. Time studies are equally illuminating when made upon a group of men all of one class and all doing the same work, in which circumstance, as with haulage, for instance, the load factor depends primarily upon the co-ordination of the mine work as a whole, or at least upon co-ordination within wider limits than within the group itself.

Mechanical Studies—Closely allied to time studies are other studies of procedure, of equipment, or of labor, in which the ascertainment of the degree of working efficiency is more directly the aim; that is to say, the work done is measured in addition to times being taken. Such mechanical studies are usually made on individual machines or men, limited in number.

Pioneer and most classic of this type of study were the motion studies of F. W. Taylor, a description of which was published in 1895 under a title which first introduced the term "scientific management." Taylor studied the motions of men doing simple physical repetitive work, and therefrom was able so to arrange the mutual positions of work and man that many motions were eliminated, and much more useful work could be done by the man at no greater or even at less expenditure of energy. Taylor designed the man to work as a machine, a design which is possible of application where the work is simple and requires little or no intelligence. Eliminating waste motions, he obtained standard methods for elemental operations. Adopting these methods he took a first-class man and timed him for the several operations of a complete job. Adding these several times together without allowance for breathing spaces, he obtained an unachievable "standard minimum time" for the job. To this he applied a *fatigue factor,* dependent on the conditions, and thus obtained a "standard time" for the job, based on the best man. This fatigue factor became in effect a discrimination against bad conditions and bad equipment, and its recognition led to greater efficiency in the particular industrial performances studied.

In mining, by reason of more complex nature of the work; because of the initiative and intelligence demanded; and owing to the extent to which machines are used, there is less scope for the application of this type of study to man. It has been applied, and with pronounced success, to manual shoveling and is doubtless applicable to similar simple tasks. It is, however, rather to machine operation that these mechanical studies are applied today. The extent to which power is used in mining has already been mentioned. Mechanical power costs from 1½d. to 4d. per horsepower-hour, whereas man-power costs from 10s. to 15s. Man-power costs relatively less and machine-power costs relatively more, the more complicated the work and the greater the intelligence necessary. With machines there is, of course, the investment cost—the interest cost of the money invested in them, and the amortization cost, in addition to the ordinary operating costs.

Proper design of the machine, with reference to the work required of it, is necessary to economy. The present design of the rock drill represents what can be done in improving machine design. Nowadays, a machine in a shift will break twice as much ground as before the war, and inasmuch as but one man is now required to work the machine, in place of the two men formerly required, the performance per man per machine shift has increased fourfold.

Improvement in machine design is not directly a concern of mine management, though it may be of the industry as a whole. Management is, however, responsible for giving the machine a chance: for so organizing the work that the machine shall work under good conditions, both those external and those internal to itself. For the external conditions, layout studies and time studies will give all the information desired; for the internal conditions, mechanical studies are necessary. These studies, combined, will secure greater performance and more efficient work.

Using again the rock drill for illustration, but consider-

Table II—Summary Sheet

Time Study .....

Equipment .....

Conditions .....

Observation Sheet			Individual Men	Summarized times for different occupations						
No.	Date	Observer		Journeys	Pauses	Clearing	Hewing	Packing	Loading	Tramm'g

Table IV—Classification of Time-Study Data

Processes

100 Drilling and blasting.
200 Loading and handling broken rock.
300 Timbering.
400 Distribution of supplies.
500 Installation of underground equipment.
600 Shop work.

Loading and Handling Broken Rock

10 Side-dump 700 kg. motor cars.
20 End-dump 700 kg. hand cars.
30 Side-dump 600 kg. hand cars.
40 End-dump 500 kg. hand cars.
60 Wheelbarrows.
70 Shoveled direct to chute.
80 Chute pulling direct to dump.
90 Skips and buckets.

1. Loading.
0.1 Use this decimal for number of men.
0.01 With shovels, no flat-sheet.
0.02 With shovels, flat-sheet, round-point shovel.
0.03 With shovels, flat-sheet, square shovel.
0.04 From chute with wooden doors.
0.05 From chute with straight, hinged, iron door.
0.06 From chute with arc door.
0.001 Coarse rock (many boulders greater than 10 in. diameter).
0.002 Dry medium rock (most of rock from 2 in. to 10 in. diameter).
0.003 Dry fine rock (most of rock less than 2 in. diameter).
0.004 Wet, moderately sticky rock, some large boulders.
0.005 Wet, sticky rock, mainly fine.

2. Car tramming, suffix "M" for motor haulage. State number of cars per train. "L" for loaded. "E" for empty vehicles.
0.1 Use this decimal for number of men.
0.01 Distance in 50 M. Use subscript numbers for multiples beyond e.g. 0.00_2 = 500 M., 0.01_2 = 550 M., and so on.
0.001 Grade in ½ per cent; suffix "U" for grade against load. "D" for grade with load.

3. Switching and spotting cars or trains; suffix "M" for motor haulage.
0.01 Entering and passing fixed-point switch.
0.02 Entering and passing movable-point switch.
0.03 Switch back, fixed-point switch.
0.04 Switch back, movable-point switch.
0.05 Spotting cars for loading.
0.06 Spotting cars for dumping.
0.001 Grade, as above.

4. Wheelbarrow tramming, dirt floor.
0.01 Distance in 5 M.; subscript numbers as under 202.01.
0.001 Grade, in ½ per cent; suffixes as under 202.001.

5. Wheelbarrow tramming, plank floor.
0.01 Distance in 5 M.; subscript numbers as under 202.01.
0.001 Grade, in ½ per cent; suffixes as under 202.01.

6. Dumping.
0.1 Number of men.
0.01 Through grizzly.
0.02 Into fill.
0.03 Clearing grizzly.
0.04 Spreading dump.
0.001 Condition of rock, as under 201.001, and so on.

9. Delays.

ing employment rather than design, Newhall and Pryce[1] in 1922 found, as the result of time studies made by them on the Witwatersrand, that out of a normal eight-hour shift only 3 hr. 39 min., measured from the time of starting the first hole to the time of completing the last hole, was available for drilling. This available time was increased to 5 hr. 9 min. chiefly by an amendment of the regulations to permit safety men to go down before the shift begins, but also by some reduction in the avoidable delays, which were shown to be greater than was usually thought. Concurrently, studies made of the gaging of the borers showed that these were far from true to their supposed gage (Fig. 2). Better gaging reduced the number of borers necessary per hole, the borer of largest gage being eliminated (Fig. 3). The hole, thus being drilled smaller, was drilled quicker; the drilling speed over the increased available drilling time was increased 30 per cent, with the highly satisfactory total result that the number of holes drilled per shift was increased 45 per cent. These particular studies and tests extended over months, the daily variations in drilling performance being so great that, in order to get reliable average figures, it was necessary to run each particular test at least a month.

Study System—Before detailed investigation is embarked on, a preliminary or general survey is made of the distribution of the total working cost among the different administrative or technical units into which the work has been divided. This survey can be made from the detailed mining accounts, and the unit costs thus disclosed will be compared with usual or best cost for similar work elsewhere under comparable conditions. Studies can then be started either where immediate attention appears most promising, and irrespective of what effect the resultant better performance may have farther down the line of operations; or they may be started at the end operation, say at winding in the shaft, and thence proceed stream upward to the productive working places, making good as they go. This latter scheme, though beneficial results are delayed, is more continuous in its operation,

[1]*Trans.* S. African Inst. Eng., Vol. 22, 1924.

Table III—Preliminary Estimate of Savings

By means of a completely organized and conducted time and motion-study program.

	Actual Current Costs				Least Cost Known at Other Plants for Similar and Comparable Conditions	Estimated Future Cost and Saving					Estimated Cost per Ton With Maximum Production Under Improved Operations	Remarks Preliminary Notation or Order in Which the Studies Shall Be Made
	Units	Total Amount	Cost per Unit	Cost per Ton		Cost per Unit	Per Cent Saving per Unit	Cost per Ton	Saving Effected per Ton	Per Cent Saving Effected per Ton		
Stoping	75,000 T.	75,000.00	1.00	0.75	0.55	0.80	20.00	0.60	0.15	7.30	0.600	6
Stope development	2,500 ft.	25,000.00	10.00	0.25	0.20	7.50	25.00	0.19	0.06	2.90	0.190	5
Exploration and development	1,600 ft.	20,000.00	12.50	0.20	0.15	10.50	16.00	0.17	0.03	1.50	0.170	4
Underground repairs		2,000.00		0.02	0.02			0.02	....	....	*0.017	
Hoisting		10,000.00		0.10	0.04			0.06	0.04	1.90	*0.050	1
Hand trimming		4,000.00		0.04	0.04			0.04	....	....	0.040	3
Electric haulage		10,000.00		0.10	0.06			0.07	0.03	1.50	0.070	2
Pumping and drainage		3,000.00		0.03	0.03			0.03	....	....	*0.025	
Ventilation		2,000.00		0.02	0.01			0.02	....	....	*0.017	
Assaying and sampling		4,000.00		0.04	0.03			0.03	0.01	0.50	*0.025	
Mine expense		10,000.00		0.10	0.10			0.10	....	....	0.100	
Total controllable expense		165,000.00		1.65	1.23			1.33	0.32	15.60	1.304	
Indirect—												
General expense		20,000.00		0.20				0.20			*0.167	
Taxes		15,000.00		0.15				0.15			*0.125	
Depreciation and depletion		5,000.00		0.05				0.05			0.050	
Total mining cost		205,000.00		2.05				1.73			1.646	
Monthly tonnage mined				100,000				100,000			120,000	

Note. Items marked * are within moderate limits, constant in amount, and cost per ton will decrease as tonnage is increased. Other costs will remain practically constant per ton.

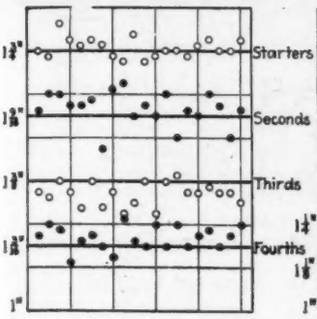


Fig. 2—Gaging chart

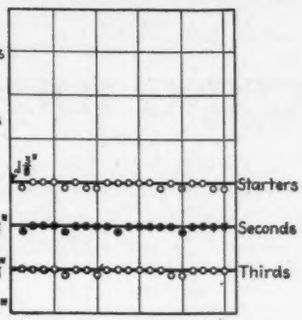


Fig. 3—Gaging chart

and the benefits mount uninterruptedly to the eventual maximum. Before it is put into operation, a proper program should be drawn up, showing the sequence in which the studies are to be undertaken, and giving estimates of the expected individual and total benefits (Table III). In making these estimates of possible economies, some preliminary and tentative studies may be made, leaving the more complete and detailed studies to follow in due course.

Indexed Classification Essential

That all the studies undertaken, in whatever category, should be capable eventually of fitting together to make a completed whole, and that each might be found in its related context in the system of filing adopted, an indexed classification of the whole underground work in detail, of the variety of working conditions in detail, and of the details of the mechanical equipment should be formulated at the beginning. Dietrich,[2] for instance, formulated for the efficiency work at the Santa Gertrudis mine, in Mexico, a decimal system (Table IV) in which each separate operation was allotted a separate and complete hundred; each sub-operation in turn was allotted a separate and complete ten; each elemental operation or occupation, a complete and separate digit; each condition a decimal fraction; and so on. To this decimal division of the operations was added a lettered classification for equipment, and other mnemonic symbols of stated significance. Such a classification allows each time study to be precisely described in convenient code form.

Fundamental among the conditions to be recorded is the physical nature of the ground, since this important factor largely governs everything, the method of mining, the proper support, the suitable machine, and in the end the performance of labor and the working cost. Accordingly, classification of the ground is essential if any reliable appraisal of performance and any equitable standards are to be attempted. In eruptives and metamorphics, for example, the main division in such a classification would rightly be one of hardness, determined by the speed of rock-drilling under uniform conditions, and probably five of such main divisions would suffice; then would come a subdivision according to the prevalence of the slips, determinable by inspection and the geological pick.[3] In sedimentaries and soft rocks other suitable bases for division would suggest themselves.

(To be continued)

[2]Dietrich, *Eng. & Min. Jour.*, Aug. 23, 1924
[3]Harley, *ibid.*, Sept. 4, 1926.

Combustion of Pulverized Coal Occurs in Four Stages

TIME after time it has been stated that pulverized coal burns like gas or oil. Nothing could be further from the truth than statements of this nature. As a matter of fact, in the powdered form a solid non-volatile fuel is in the most unfavorable condition for rapid combustion. In the burning of gas, the higher the velocity of a gas jet the greater will be the speed of combustion, provided, of course, sufficient time was given for diffusion. The speed of combustion of the gas jet would be dependent upon the degree of induction entrainment and turbulence, but the same is not true in the same measure for pulverized coal. For the latter the length of time required for combustion remains approximately the same regardless of the velocity of injection. Further, no matter how finely pulverized the coal particles may be, it remains essentially a solid, and the conditions necessary for combustion of solid carbon still apply to the "fixed carbon" constituent, which will comprise anything from 50 to 93 per cent of the total combustible matter in the coal.

Although the rapidity of combination of carbon with oxygen increases with rise of temperature, the principal limiting factor is the rate at which oxygen can be brought into contact with the carbon, and this depends on the thickness of the film of carbon dioxide and nitrogen formed on the surface of the carbon. The thickness of this film is inversely proportional to the relative velocity of the gases and solid. It, therefore, follows that the rate of combustion of the carbon is directly proportional to the rate at which air is supplied.

In the combustion of pulverized fuel four stages occur —namely (1) heating and drying the fuel, (2) gasification of the volatile matter and coking the carbon, (3) combustion of gases, and (4) combustion of the coke particles. In practice, these phases overlap to some extent and cannot be definitely separated.

The most rapid ignition and combustion possible is desired to obtain the highest furnace temperatures, and thus the highest efficiency. The small pulverized coal particle entering the furnace is first of all heated up by stages. First, any moisture in the coal must be vaporized. The drying process is endothermic or heat absorbing; that is, the furnace walls surrounding the flame must furnish this heat to raise the temperature of the incoming particles and to start distillation, which is the next stage. Though some of the radiant heat is furnished by the surrounding walls, the greater part comes from the flames of burning coal and gases. This reverberatory action of the flame is highly important, particularly with low volatile coals. The distillation change starts at about 400 deg. F., and gases and volatile vapors are given off, forming smoke until combustion starts. The distillation process is also endothermic, unless the oxygen content of the coal is high. The entering coal particle, being a black body, readily absorbs radiant heat, and increases in temperature.—Excerpts from a paper by Dr. G. E. K. Blythe, presented at the Second International Conference on Bituminous Coal, at Pittsburgh, Nov. 19-24, 1928.

USEFUL OPERATING IDEAS

Night Work Proves More Satisfactory in Hot Climate

THERE are many reasons why night work may prove desirable or advantageous to certain industries. When harassed by adverse weather conditions, the farmer has learned to utilize artificial illumination to save his crop. The road builder, the structural worker—in fact, workers in many trades—have likewise learned that night work may prove profitable. Although storms are the main cause for suspended operations in most outdoor work, extreme cold or heat may likewise be contributing factors. The last-named cause was the determining factor in the following instance. The successful solution of the problem makes a story worth recording.

A large quarry in Texas found difficulty in keeping men at work in the pits because of the extreme heat during most of the day. The situation became so acute as to almost suspend operations. Then the manager decided to work nights instead of days. The men took readily to the idea, and the plan proved a big success.

The quarry is far from the nearest town of any size, and consequently the question of illumination called for a portable outfit that would provide adequate illumination and require minimum maintenance expense. These conditions were met by the adoption of acetylene floodlights, using cakes of processed carbide called Carbic. The lights are easily moved about and are controlled by unskilled labor.

The accompanying illustration shows the amount of illumination thrown by one light. At the time the photograph

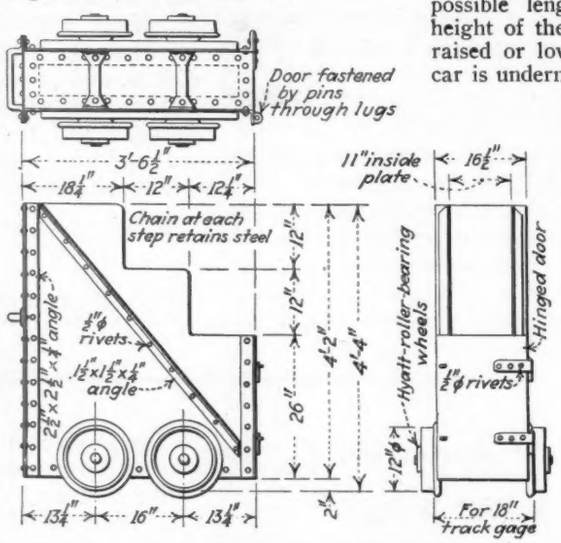
Illuminating a quarry for night work

was taken a sandstorm was raging, yet the flame from this light stubbornly resisted a wind of almost gale force. A storm-proof burner is used. This type of floodlight is foolproof and safe, even under the most extreme conditions. If it is accidentally upset, the water in the generator simply runs out and gas generation stops immediately. This characteristic and other features cause it to be listed as standard by the Underwriter's Laboratories, Inc.

Cost per hour of service is low. The Carbic cakes are self-feeding under a gas bell arrangement. When the light is shut off, generation of gas ceases, and the unused part of the cake is saved for future use. Cakes may be left in the holder, or, being dry, solid and clean, can be slipped back into the original drum for future use.

Handling of Steel Facilitated by Special Car

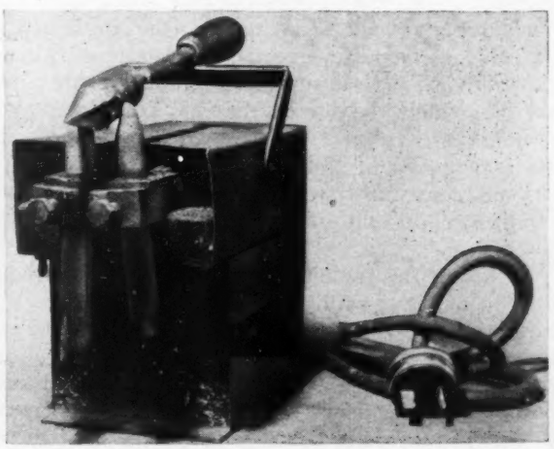
A CAR designed for carrying drill steel underground is illustrated in the accompanying drawing. It is made by the Wabi Iron Works, New Liskeard, Ont., and is in general use in the mines of the Kirkland Lake district, among others. The three sections of the car are not separated by partitions, although the car is designed to facilitate handling of steel of different lengths. Maximum possible length is determined by the height of the cage on which the car is raised or lowered. The bottom of the car is underneath the axles and fastened to them. Steel is kept from shifting by the axles, which are thus inside the body. The car is so made that the bottom is as close to the ground as possible.



A car for transporting steel underground

Low-Voltage Soldering Iron Found Useful

A LOW-VOLTAGE soldering iron has been developed by the staff of the Utah Copper Company's Magna plant. The device is made in two types, one portable, which can be connected with a 110-volt lamp socket, and the other a large permanent unit with 440-volt primary circuit, which is cut to a secondary of 6 to 9 volts, 300 to 400 amp. The secondary current terminates in copper clamps which hold the carbons. These are placed about half an inch apart, and the soldering iron is laid in the gap. The heat from both the contact resistance as well as the passage of the current heats the copper.



This low-voltage soldering iron is made in portable and stationary types

Determination of Non-Sulphide Lead and Zinc

THREE or four years ago, while I was connected with the Snowstorm Silver Lead Company at Troy, Mont., as chemist of a custom concentrator, it became necessary to devise a method of determining the amount of non-sulphide zinc and lead in our ores, writes B. W. Moye. Neither before nor since have I seen in print a method for analyzing this class of ore, which includes carbonates, oxides, and sulphates of zinc and lead, but not the silicates. I have been asked several times for my method, and believe it might be of interest and help to some of the readers of *E. & M. J.* Details of the method follow:

Non-sulphide zinc: To one gram of ore, add 5 grams of ammonium chloride, 10 cc. concentrated solution of ammonium acetate, and 25 cc. hot water; cover with a watch glass and allow to boil gently for 10 min. Filter hot and wash with hot water containing a little ammonium chloride. Acidify the filtrate with 5 cc. hydrochloric acid, add 10 cc. hydrogen peroxide, and 15 cc. ammonium hydroxide, and boil until most of the ammonia is expelled. Filter off the ferric hydroxide and wash with hot water. Acidify the filtrate with hydrochloric acid; add 5 grams of test lead and titrate with potassium ferrocyanide.

Non-sulphide lead: To one gram of ore, add 10 cc. concentrated solution of ammonium acetate and 20 cc. hot water, and boil gently for 10 min. Filter hot and wash with hot water, keeping the filtrate as low as possible. Add a few drops of nitric acid and 10 cc. sulphuric acid, and take to fumes. Then follow any standard method for the lead determination. Duplicates should check within 0.2 per cent.

In the development of this method I wish to acknowledge the suggestions and help of George W. Griswold, Jr., of the Timber Butte Mining Company, who was consulting metallurgist for the Snowstorm at that time.

How to Weld Monel Metal

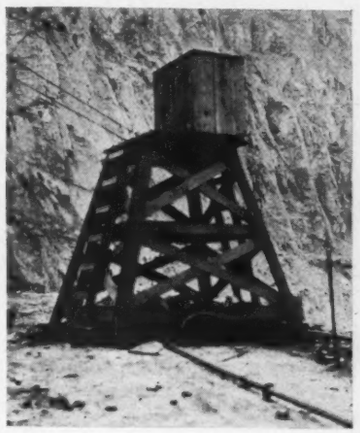
IN WELDING monel metal a few simple precautions must be observed. First, a neutral flame should be used. The tip should be one or two sizes larger than would be required for steel of the same thickness. Cold drawn monel-metal wire or strips, cut from a sheet, should be used as a welding rod. As a general rule, flux is not required. The oxide film that forms on the surface of the puddle helps to protect the metal underneath from further oxidation. Keeping the outer envelope of the flame spread over the weld area will also aid in excluding air. The rod should be melted under this skin of oxide and slag. Any particles of dirt or foreign matter should be worked up into the slag by melting underneath them. Then, when the weld is built up well above the surface, as all monel metal welds should be, grinding will remove oxide, slag, and impurities, leaving only good sound metal in the weld.

Monel-metal castings present a peculiar combination of properties. Like gray cast iron, they are sensitive to sudden temperature changes while under the welding flame. Consequently, such castings must be carefully preheated, welded while hot, and allowed to cool very slowly. Like cast aluminum, monel castings have very little strength when hot, so the piece must be properly supported in the preheating furnace in order that the various parts of the casting do not collapse or distort under their own weight. The casting should be brought to an even dull red heat of about 1,200 deg. F., and the temperature maintained as uniformly as possible during the welding.

When the weld is completed, cover all openings of the preheating furnace with asbestos paper, close the draft holes with sand, and allow the casting to cool gradually in the dying fire. Do not uncover until the casting is stone cold.

An Aid in Turning Night Into Day

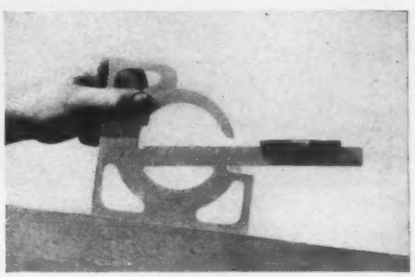
ADEQUATE floodlighting for night operations is an important feature of current extraction methods employed at the open pit of the United Verde Copper Company situated at Jerome, Ariz. The type of support and housing used for the high-powered lights, placed at vantage points in the pit, is shown in the accompanying illustration. Several benches are being worked, and about 2,000 tons a day is broken. Bucyrus shovels, of the full revolving type mounted on caterpillar tractors, deliver the various grades of ore and waste to Moreland six-wheel trucks for transport to the ore pockets.



Support and housing for floodlights

Draftsman's Protractor Measures Launder Grades

HAVING had occasion to determine the grades of about 200 launders in an operating mill where the measurements had to be made under adverse conditions and in a limited time, a special method was developed, writes F. W. Collins. A Brown & Sharpe draftsman's protractor is used, with a small level clamped on the arm of the protractor, as shown in the accompanying illustration. By placing the base of the protractor on the side board of the launder and bringing the arm to a level, the angle of slope is read quickly. From Smoley's table the grades in inches per foot are obtained. If the top of the launder is not parallel with its bottom, a board held across the bottom by an assistant gives the necessary base for the reading. The following table, which is correct to the nearest minute of arc, contains grades in inches per foot and corresponding angles:

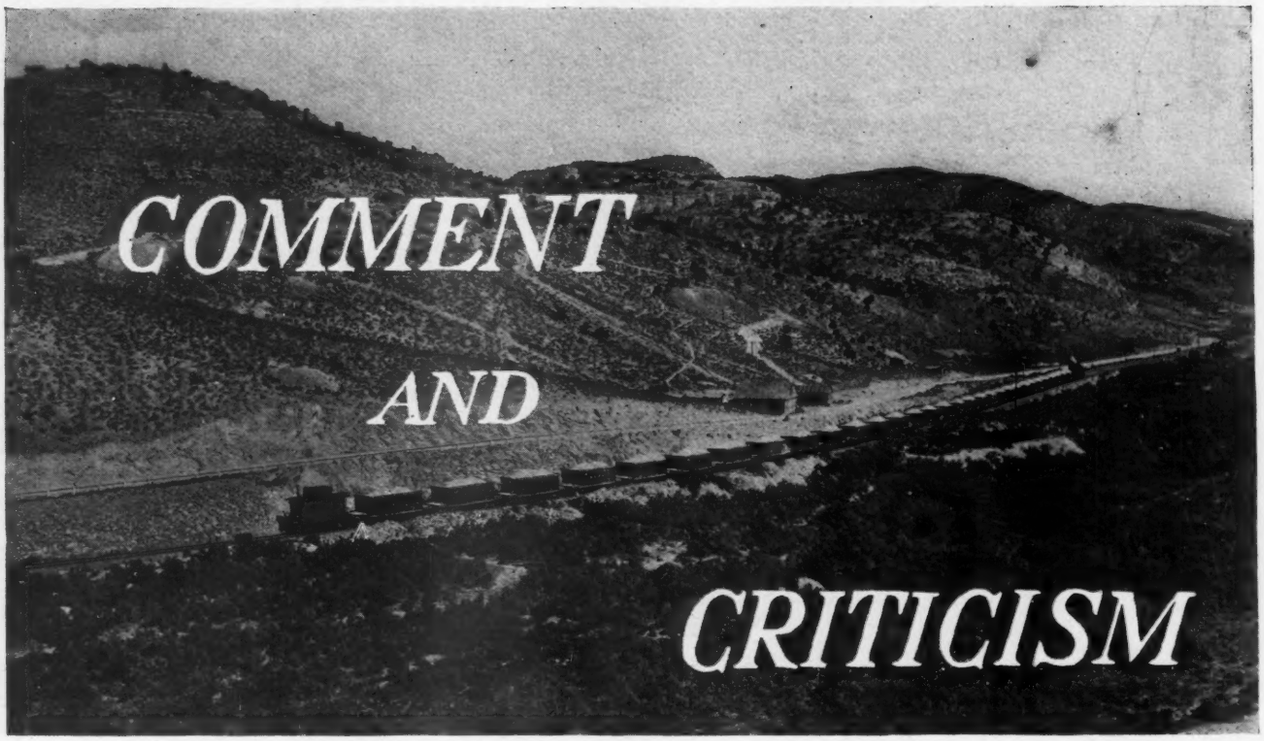


Protractor and level used for determining launder grades

Slope in Inches per Foot	Angle of Slope Deg.	Min.	Slope in Inches per Foot	Angle of Slope Deg.	Min.
1/16	0	18	1 1/16	6	32
1/8	0	36	1 1/8	7	08
3/16	0	54	1 3/16	7	43
1/4	1	12	1 1/4	8	18
5/16	1	30	1 5/16	8	53
3/8	1	47	2	9	28
7/16	2	05	2 1/8	10	03
1/2	2	23	2 1/4	10	37
9/16	2	41	2 3/8	11	12
5/8	2	59	2 1/2	11	46
11/16	3	17	2 5/8	12	20
3/4	3	35	2 3/4	12	54
13/16	3	52	3	14	02
7/8	4	10	3 1/4	15	09
15/16	4	28	3 1/2	16	16
1	4	46	3 3/4	17	21
1 1/8	5	21	4	18	26
1 1/4	5	57			

When Polishing Lathe Work

Unless pressure is used, when polishing shafts and rods in the lathe with emery cloth, proper results cannot be obtained, according to R. M. Thomas. If the cloth is placed around a block of wood and the block placed between work and tool in the tool post, enough pressure can be applied to give a good polish without additional labor on the part of the operator. Plenty of oil is needed, as a lasting polish cannot be obtained and the work will be scratched if the operation is performed dry. The best way to make the polish uniform is to use the thread-cutting attachment, applying oil as required to keep the work moist.



A Platinum-Mercury Anomaly

To the Editor of "E.&M.J.":

The object of this letter is to bring out some interesting facts, the result of research, in explaining an unusual property of platinum in contact with mercury. The opinion is prevalent that platinum amalgamates with mercury in the presence of sodium. However, while experimenting with sodium amalgam, an iron spatula, accidentally immersed in it, immediately acquired a coating of mercury. The spatula was left in a beaker of water over night, during which time the mercury separated and was found in small globules on the bottom of the beaker. The iron acquired a deposit of metallic sodium, which was immediately wetted or enveloped by the mercury.

Other metals of the iron and platinum group act similarly with sodium amalgam. Mercury and gold form a stable amalgam, but platinum is inert to mercury. However, in the presence of sodium, mercury apparently combines with the platinum, but if much water is present the platinum and mercury separate. Others have noticed this interesting phenomenon. David T. Day and R. H. Richards[1] noted that platinum metals have a curious relation to mercury. So long as the sodium amalgam is rich in sodium they amalgamate perfectly, but as soon as the sodium is spent, the platinum metals leave the amalgam and refuse to remain combined with it. They stated that "this property will prove of value in cleaning the platinum metals, for they can at first be separated from the sand with the gold, and then, by simply standing in water, the gold and platinum amalgam parts into gold amalgam and free platinum grains, which can be easily separated in the pan." H. R. Adams, in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa of Aug. 21, 1926, also discusses the subject.

Why should it be comparatively easy to wet gold with mercury and so difficult to wet platinum? The success which has so far been attained seems to depend on the production of hydrogen at the platinum surface.

T. K. Prentice and R. Murdoch[2] likewise attribute the phenomenon to the formation of hydrogen. They state that, "The nascent hydrogen with zinc amalgam forms hydrogen zinc amalgam, which, like hydrogen sodium amalgam, has a remarkably powerful amalgamating action and an affinity for platinum." In the amalgamation of gold no water or any additional reagent is required to produce an amalgam, whereas with platinum and mercury, water and sodium are essential for the envelopment of the platinum by mercury. I use the term "envelopment" because the apparent combination is not a real amalgam like gold or silver amalgam.

Sodium combines with mercury to form an amalgam, an active compound that decomposes water with great energy. Generally such chemical change produces electrochemical action, and under favorable conditions is capable of yielding electrolytic effects—such, for instance, as the deposition of metals. This joint chemical, electrochemical, and electrolytic action is what causes platinum to be enveloped by mercury when treated with sodium amalgam. In other words, it is a local electrodeposition of sodium on the platinum surface, accompanied by an instantaneous amalgamation of the sodium-coated platinum. This is an interesting phenomenon in respect to sodium, in which a metal is changed to a compound, again reduced, and deposited in metallic condition on an electronegative metal higher in the electric series.

To corroborate this theory of simultaneous change and reduction, another illustration is afforded by zinc. Introduce a few granules of zinc and some mercury into a strong sulphuric acid solution (about 25 per cent acid by weight); then throw a piece of platinum wire, about ½ in. long, or a few grains of native platinum into the acid, and observe how readily the platinum will be enveloped by the mercury. Because of the energetic local chemical and electrical reactions brought about by the zinc, acid, mercury, and platinum, the zinc is caused to deposit itself on the platinum. The physical effect is similar to that which takes place with the sodium amalgam. However, in the latter instance the combination is of short duration, whereas the combination of the platinum with mercury, in respect to the zinc amalgam, is permanent.

When platinum is treated with sodium amalgam, the platinum will remain in the mercury as long as it contains a sufficient amount of sodium; but when the sodium is acted on by water, or is spent, the mercury refuses to remain combined with it. This can be considered to be proof that platinum does not amalgamate with mercury. If it formed an alloy, as it does with other metals, the reaction of the sodium with water would have no effect on the com-

[1] "Mineral Resources of the United States," 1905.

[2] *Journal* Chem., Met. & Min. Soc. of South Africa, Jan. 19, 1929.

bination between mercury and platinum, although the two metals remain together as long as the film of sodium lasts. In respect to the zinc amalgam, zinc is not decomposed by water with any degree of avidity. After being plated onto the platinum it is permanent, and can be stripped only by heating or by dissolving in nitric acid.

The discovery that platinum can be permanently retained in the mercury by first producing a coating of a stable metal on the platinum surface led to the practical use of the zinc amalgam in separating fine particles of platinum from black sands collected in the riffles of hydraulic mining sluices and tables on gold dredges. Laboratory experiments were made and platinum was recovered, as well as an appreciable amount of gold that could not be detected in panning.

The process could be applied only to the treatment of an enriched product or concentrate. Black-sand concentrates consist principally of chromite, ilmenite, magnetite, and incidental lead shot, babbitt metal, copper and iron chips. During mining and sluicing operations, the iron particles rust and become cemented with the black sand, forming nodules in which are included the gold and platinum. Grinding is therefore necessary, whereby the platinum and gold are likewise comminuted and their final recovery is made more difficult. A high extraction by the zinc amalgam process is difficult to obtain when the valuable particles are extremely fine, but a method has been evolved.

In some platiniferous areas the platinum is not only free, but is also included in the chromite grains, necessitating grinding of the concentrates. Since the discovery of "lode" platinum in South Africa the metallurgy involved has become more difficult and complicated.

A unit having a capacity of ten tons of platiniferous concentrate per day was installed at the factory of Shreve & Company, San Francisco. It consisted of a small ball mill, a shaking screen, and a 5x8-ft. amalgamating plate, mounted on four springs. A shaking motion was imparted to the plate by eccentrics. A solution tank for the dilute sulphuric acid solution, a sump box, a settling box at the foot of the table, and a 1½-in. centrifugal pump to return the sump solution to the solution storage tank were provided. Zinc amalgam was prepared by pouring molten zinc into mercury, cooling the mass, and pulverizing it in a mortar. Zinc amalgam was added at intervals to the black-sand feed hopper above the amalgamating table, thus insuring its even distribution through the mass of concentrate in the hopper. The sulphuric acid solution washed the concentrate down the table and into the settling box, the overflow passing into the sump tank, where it was brought up to strength and pumped back into the solution storage tank for re-use.

Amalgamation of the platinum was almost instantaneous; 95 per cent of the platinum was caught upon the first 18 in. of the plate. Cleanup of the amalgam, containing platinum, gold, and osmiridium, followed gold milling practice. Gold was separated as an amalgam by placing the amalgam in a large quantity of quicksilver and allowing to stand quietly for several hours. In this way the platinum metals were stratified and could be separated. After retorting, the crude platinum was subjected to the usual platinum refining operation and then fused in a lime crucible by an oxy-hydrogen flame. It was rolled into plates and sent to the jewelry manufacturing department.

The black-sand concentrates from many hydraulic mines and gold dredges in the Pacific Coast region varied in richness as well as in composition, invariably necessitating modifications in the treatment prior to amalgamation. As shipments were spasmodic and usually limited to small lots, to secure continuous operation the treatment of concentrates of much lower value was necessary. Tailing losses on richer concentrates are higher. A concentrate worth $5 per ton could be treated by the zinc amalgam process, but obviously such a low-grade product could not be shipped to a plant in San Francisco. The conclusion was reached that it would be advisable to operate plants at the mines, but the company decided to continue operations for the treatment of casual shipments only, and not to expand, and I therefore discontinued my connection with it.

In placer mining, as at present conducted, a large proportion of the platinum, osmiridium, and fine gold is lost. J. W. Neill[1] demonstrated the losses in fine platinum that occurred on his dredge at Snelling, Calif. Promising deposits along the Trinity and Klamath rivers could have been operated so as to yield platinum and osmiridium had there not been such a large percentage of fine heavy black sand in the gravel, which interfered with the proper functioning of the riffles, necessitating increased sluice grade or increased water volume. Fine platinum could be saved by dispensing with the riffles and using a series of Neill jigs, thus eliminating the large bulk of gravel and coarse sand and giving a low-grade product that would contain the fine platinum. This product could be enriched by further concentration until a product sufficiently rich for the zinc-amalgam process was obtained.

Analysis of the product from the Snelling dredge indicated 97.7 per cent platinum and 2.3 per cent osmiridium. At the Bonaly hydraulic mine, in the vicinity of the Klamath River, the platinum was 2.25 per cent and osmiridium 97.5 per cent. Although formerly most of the osmiridium came from the Adams and Savage River field, in Tasmania, during the last few years South Africa has become an important producing center as a result of byproduct recovery in the operation of some of the gold mines. I am now investigating the possibilities of recovering osmiridium from some of the alluvial deposits in northern California. VICTOR I. ZACHERT.

San Francisco, Calif.

[1] *Min. & Sci. Press*, Dec. 8, 1917.

Self-Educated Engineers Can Aid Mining Industry

To the Editor of "E.&M.J.":

Inclosed is a short appreciation of William Hanna. He was one of the hardy and able race of self-educated young engineers in Central America, who admitted that *Engineering and Mining Journal* had been the source of much of his technical knowledge. I feel that he would have been glad to record a gratitude that it is now too late for him to express. CHARLES BUTTERS.

Oakland, Calif.

[The appreciation by Mr. Butters has already been published. *Engineering and Mining Journal* regrets the early loss to the mining profession of such an unusually useful life. It is satisfying to know, however, that this publication was of value to Hanna and that he so expressed himself to his associates. Many a self-educated man, even though holding a responsible position, is hesitant to acknowledge that he has achieved such a position without the aid of a college training and rarely expresses his views freely among his associates. On the other hand, should his ability become widely or nationally recognized, he points with pride to the fact that his theoretical learning, at least, has been acquired solely by his own efforts; and, moreover, he is usually willing that his experiences be given publicity. This initial hesitancy on the part of so many self-educated engineers should be discouraged, for it denies to others much information that might be shared to mutual advantage. *Engineering and Mining Journal* desires to serve as a source of learning to the self-educated, but it also would like to be a medium for disseminating the valuable knowledge that many of these members of the profession have gained and applied with success. This broader service is a function and obligation of the technical press; co-operation from the profession would help in the performance of this duty.—Editor.]

Indo China Has Latent Mineral Possibilities

To the Editor of "E.&M.J.":

Industrial develoment of Indo China has not made much progress yet, but efforts are being made toward the utilization of the country's mineral resources. Important deposits of zinc ore are found largely in the northern part of Tonkin. The upper beds, now under exploitation, generally contain zinc carbonate and silicate; at greater depth only blende is found. One mining company

has built a smelting plant near Haiphong harbor. In 1928, this organization produced 38,000 metric tons of calamine and 1,170 tons of zinc.

Of greatest interest, probably, has been the discovery of cassiterite deposits in the Province of Laos, west of French Indo China. High-grade material is reported to exist, but means of communication are poor. Prospectors, however, are thoroughly exploring this region, and, with adequate transportation, an industry of importance may be built up. At present only a few mines in the northern part of Tonkin are being exploited for tin.

Other minerals are also found, but for the present they must remain untouched, as the deposits are either too small or are in virtually inaccessible locations, where neither transportation nor labor is to be had. Of these, gold, lead, antimony, graphite, iron, cinnabar, and oil might be mentioned. Phosphates are being exploited and sold for fertilizer.

I feel sure that Indo China has a promising future as a mining country, but prospecting is difficult because of the climate and the heavy jungle. And, of course, the transportation problem is almost insuperable. One mine I know of ships ore by means of buffaloes over a mountainous region.

GEORGE ROY.

Nam-Dinh, Indo China.

BY THE WAY

"Fine-Feathered" Concentration of Diamonds

GOLD, they say, is where you find it. Diamonds, too, are where you find them. So at least, believes the American Trade Commissioner at Johannesburg, South Africa, Samuel H. Day, who has reported to the Department of Commerce that hunters in the Kalahari Desert have taken from the gizzards of two wild ostriches seventy stones of exceptional quality. The rich possibilities of hunting and mining combined threaten the destruction of the great birds of the desert region yet untamed.

It is surmised that ostriches, as keen for diamonds as pigs for truffles, find the gems the most valuable aids to digestion, as unquestionably they are in the marketable rating. The hunters' discovery may throw light on that legendary stupidity, the myth of which simile-stocked orators never tire, that the ostrich hides its head in the sand. The bird that was seen to do that was seeking not concealment but a post-prandial diamond. A display of dietary wisdom was mistaken for the silliest of attempts at invisibility.

The trade commissioner of Johannesburg tells the story of the diamond-lined ostriches in few and sober words. The Department of Commerce does not disclose whether or not Mr. Day is a native of Winsted, Conn., or has ever been intimate with the Winsted school of naturalists. — New York *Herald-Tribune.*

Rewards for Suggestions

THE one fundamental difficulty about every suggestion system is the apparent impossibility of determining the true worth of any new idea before it has been tried out. If a firm puts up a five-dollar prize it will get a great many two-dollar suggestions, a few four-dollar ones, and, once in a blue moon, a ten-dollar one. As a gamble it is a losing one. A suggestion that is worth only five dollars is no suggestion at all. A suggestion that will save or gain for the firm a thousand dollars a year for five, ten, or twenty years is very much worth while, but the man who drops it in a suggestion box that has a five-dollar label does not deserve even the five dollars. He should be given a ticket to the nearest hospital for the weak-minded.

Every employer has men, and foremen, too, whom he suspects of holding out ideas on him. At times employers are right. The way to get a holdout to sign on the dotted line is to make the inducement worth while.

Since no one knows what an idea is worth until it has been put to work, why not put it to work and share the gain with the man that invented it? Why not offer the man a share in the net profits from the use of the idea, even if it is not patentable? To be sure, there are men who would rather have ten dollars today than hope of a hundred a year for life, on the score that they may not live to get the first hundred, but there are plenty of others who will say to themselves, "If I can get a hundred a year for a hundred suggestions, why not?"— "ENTROPY" in *American Machinist.*

The Munroe Effect

THE feature of a luncheon marking the eightieth birthday of Dr. Charles E. Munroe, chief explosives chemist of the U. S. Bureau of Mines, Washington, D. C., was the presentation to Dr. Munroe of a bronze medal bearing his portrait, the outlines of which were blown into the metal by means of the "Munroe effect." This is a phenomenon discovered by Dr. Munroe, which permits the reproduction of drawings and designs upon metal through the detonation against the metal of an explosive upon the surface of which the design has been impressed as from a zinc etching.— *Science.*

Consultation

An Engineer's Services Needed

For the last few years we have been interested in a coal property, and we are proud of the fact that it is running successfully, in spite of the hard knocks with which the bituminous industry has had to contend in the last few years.

We are now planning on looking into the metal end of mining, and would appreciate having your report in answer to the following questions:

1. *Is it possible for a 50-ton mill to do any better than to carry first-class overhead under the following conditions: The ore is a sulphide, having an average assay value of $13. According to a metallurgical engineer's report, the ore can be treated readily by flotation. Elevation of the property is 9,500 ft; power is obtained from a Diesel engine installation; ample water is available for milling; a good road connects the property with the shipping point, three miles distant; and four smelters are within reasonable shipping distance.*
2. *Can a 50-ton cyanide plant situated eight miles from a railroad operate at a profit when treating quartz ore hoisted 400 ft. and assaying $5 gross?*

Numerous articles and news accounts relative to small-scale mining and milling operations have been published in recent issues of *Engineering and Mining Journal.* Perusal of this material will reveal what has been accomplished by some of the small-tonnage producers. Rather than using such information, however, as a basis for determining the possibilities of the properties in which you are interested, we suggest that you engage a competent mining engineer to examine and report on the properties.

Buyers of Zinc Flotation Concentrate

IN the issue of June 15 several foreign companies were listed as possible buyers of zinc flotation concentrate. We have since been informed that the "Berzelius" company, of Duisburg, Germany, which is owned by the Metallgesellschaft, is represented in North America by The Ore & Chemical Corporation, of 40 Rector St., New York City, and that any inquiries regarding the sale of ore emanating from the United States, Canada, or Mexico should be addressed to that company, which is at all times in position to buy zinc concentrates for the account of the Metallgesellschaft. Messrs. Aron Hirsch & Sohn, of Berlin, are represented in the United States by Charles Hardy, Inc., 122 East 42d St., New York City, who are also in the market for zinc concentrates for export. A demand also exists in Japan for material of this kind, with Mitsui & Company, 65 Broadway, New York City, as American agents.

Personal Notes

John Leath is in charge of operations for Caledonian Mining, in the Silverton district of Colorado.

Le Roi Thurmond is spending the summer and fall exploring the Chulitna River district, Alaska.

A. H. Head has been appointed manager of Pride Mining, in the Silverton district of Colorado.

James Gordon McDonald, president of the Rhodesian Chamber of Mines, was recently knighted by King George.

W. S. Burbank, of the U. S. Geological Survey, is doing detailed mapping in the Ouray quadrangle in Colorado.

Dean Fowler has been elected president of the Lexington Consolidated Mines Company, of Idaho Springs, Colo.

W. E. Dunlap is superintending operations at the property of the Potter Mines Company, southwest of Yucca, Ariz.

Thomas P. Cates was elected president of the Ardsley Butte Extension Mining Company, at its recent stockholders' meeting.

John D. Ryan, of New York, chairman of the board of directors of Anaconda Copper, and Mrs. Ryan are in Michigan, to remain there for several weeks.

Ira B. Joralemon and **Durand A. Hall,** both of San Francisco, will make a geological study of the properties of Canam Mex Mines, Ltd., in Zacatecas, Mexico.

Frank W. Griffin, California dredge operator, is en route to the Bulolo River dredge field, in central New Guinea, where he is planning to install two gold dredges.

R. G. Hudson was elected secretary of the New Jersey Zinc Company to fill the vacancy caused by the resignation of **A. P. Cobb,** who continues as a vice-president.

Alfred C. Lane, Pearson professor of geology and mineralogy at Tufts College, is doing professional work in Michigan for the Pure Oil Company this summer.

C. M. Bell, geologist, and **J. P. Ruth,** metallurgist, are making an examination of the Gold King mine, in the Silverton district, Colorado, operated by **W. Z. Kinney.**

R. D. Leisk, of Jerome, Ariz., will sail from New York on Aug. 31 for South Africa, where he will visit properties of the South African Copper Company, Ltd., in Namaqualand.

J. E. McDonald, of Coeur d'Alene, Idaho, is president of the Coeur d'Alene Mountain Mining Company, recently incorporated to operate seven claims in the Beauty Bay district of Idaho.

H. O. Dyer is superintending exploration for Consolidated Mining & Smelting, Algoma district, Ontario. He is at present at Goudreau, where the company has three properties under option.

James M. Hill, consulting geologist, Berkeley, Calif., who recently returned from an examination of quicksilver mines in Lake County, is now in northern California examining pumice claims.

William A. Paine and **F. Ward Paine,** of Boston, president and treasurer, respectively, of the Copper Range Company, are visiting the properties of the company in the Michigan copper district.

F. A. Merrick was recently elected president of the Westinghouse Electric & Manufacturing Company by the board of directors of the company, at a meeting in New York City. After having completed his technical education at Lehigh University, Mr. Merrick was employed by the Steel Motors Company. While he was manager of Steel Motors, that company was acquired by the Westinghouse organization. He has risen steadily in the company, and has been a director since 1925. When the United States entered the war, Mr. Merrick, although required to reorganize and re-equip his factory, completed an order for 60,000 machine guns within eleven months after operations were begun. This manufacturing achievement has since been regarded in the industrial field as being without parallel.

F. A. MERRICK

Dr. **G. A. Muilenburg,** associate professor of geology at the Missouri School of Mines, is spending part of the summer examining mineral deposits in western Texas, New Mexico, Utah and Wyoming.

Harold S. Falk, vice-president and works manager of the Falk Corporation, Milwaukee, Wis., has been appointed chairman of the committee on industrial education of the National Metal Trades Association.

George Long is in charge of operations for Imperial Mining, which has taken over the property formerly owned by United Western, in the Oatman district of Arizona.

Edwin Kirk, of the U. S. Geological Survey, left Washington recently for Colorado, to join the parties studying the Paleozoic stratigraphy of the region. He will go to Utah later, and expects to return to Washington in September.

R. S. Dening has resigned as managing director in Canada for the Huronian Belt Company, which controls the Keeley Silver and Vipond Consolidated properties, in the South Lorrain and Porcupine districts of Ontario, respectively.

Cliff Carpenter, president of Arizona Magma, operating near Chloride, Ariz., is now in New York City in connection with the installation of additional equipment at the Diana and Bella Union mines, which his company operates.

Carl K. Dresser, president of the Dresser Mining Company, is now in the San Juan district of Colorado, superintending operations at the Garry Owen and Veta Madre mines.

O. H. Caldwell, formerly of the federal Radio Commission, has been designated to serve as a member of the Communications Committee appointed by the American Engineering Council to work with Congress on engineering problems relating to communications.

Frank A. Wardlaw, Jr., manager of the Utah-Delaware mine of International Smelting, the Utah unit of Anaconda Copper, has been appointed manager of the Utah mines of the company. Mr. Wardlaw has served in his present capacity for the last five years, and was formerly superintendent of the Highland Boy mine, at Bingham.

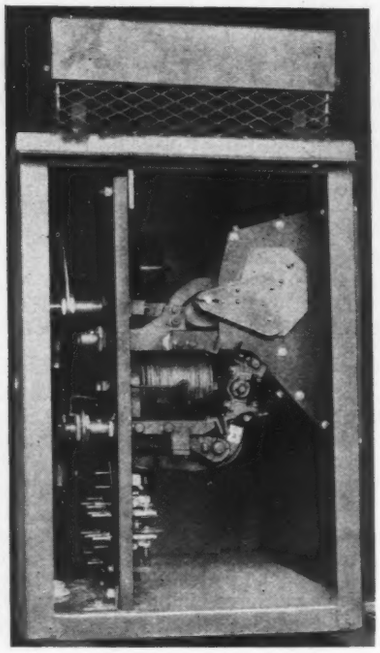
Olaf P. Jenkins has recently been appointed Chief Geologist to the California State Division of Mines and Mining, and is taking charge of the newly established geologic branch of this division, which is under the supervision of **Walter W. Bradley,** State Geologist. Mr. Jenkins was formerly with the Kentucky and Washington state geological surveys.

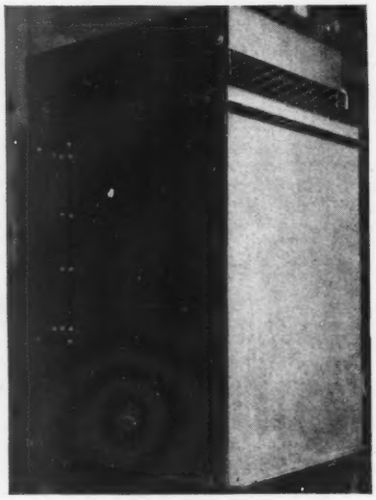
Pope Yeatman, of the firm of Yeatman & Berry, consulting engineers, of New York City, has completed an examination of the Malartic mine for the directors of Malartic Gold Mines, Inc. It is in Fourniere Township, about 35 miles from Amos, Que. Mr. Yeatman spent a week at the property, and was assisted in his examination by **Andrew Walz,** of Toronto. The report is expected to be ready in about a week.

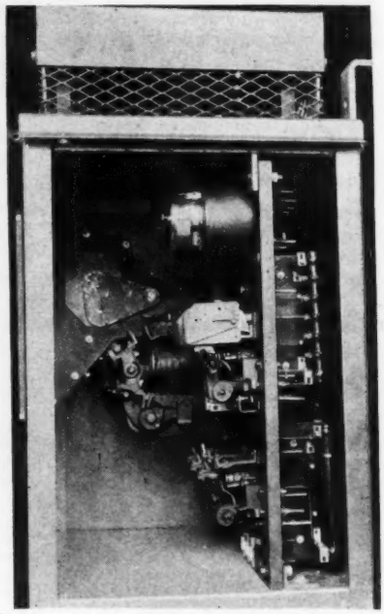
OBITUARY

H. J. Porter, formerly president of the Lexington Consolidated Mines Company, Idaho Springs, Colo., died late in June, after a long illness.

John Holtcamp, old-time Colorado prospector and miner, died at Silverton on July 9. He was 78 years of age, and had been in the San Juan district for the last 35 years.







Three views of the new automatic reclosing feeder

Automatic Reclosing Feeder Has Wide Application Underground

By Herbert S. Littlewood
Westinghouse Electric & Manufacturing Company

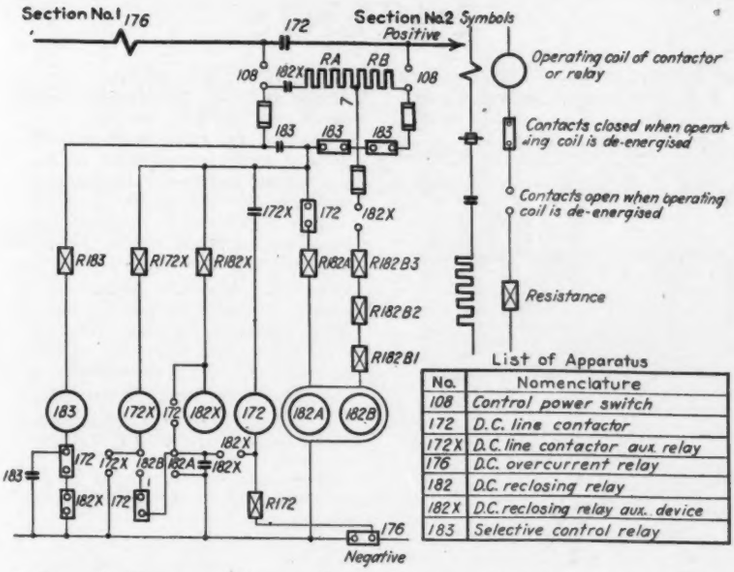
A NEW automatic feeder equipment has been designed for application in the sectionalizing of mining feeder circuits. Its purpose is to give an increased interrupting rating and to provide an equipment for universal application. In the past the general practice has been to design automatic reclosing feeders with a control scheme and mounting for each individual class of application. The new feeder may be satisfactorily applied at any location on a mining distribution system, for automatically controlling feeder circuits, using the resistance-measuring principle. Furthermore, the equipment is inclosed in a weatherproof sheet-steel housing, thereby making it applicable to both outdoor and underground sectionalizing service. The increased interrupting ability of the circuit interrupter was made possible by the addition of strong "kick-out" springs, redesign of the magnetic circuit, extension of the arc chute to the exterior of the housing, and obtaining positive sealing by rapid closing action. In view of the foregoing, therefore, it becomes possible to standardize on one type of equipment, with a consequent reduction in first cost, cost of spare parts, stocking, and storage charges.

The advantages of automatically sectionalizing mining feeder circuits are that they protect the system and apparatus against abnormal conditions, insure the best feeder performance, permit saving in labor charges, localize faults, and minimize the time the service is interrupted. These advantages lead to a reduction in operating cost and an increased output from the mine. From a safety standpoint, the most important protective function of this equipment is to provide for the localization of trolley faults, or grounds. These faults are usually sufficient to present a serious fire hazard and should, therefore, be guarded against.

The schematic diagram, Fig. 1, illustrates the scheme of operation of the standard automatic reclosing feeder. For a brief description of this operation, assume that the feeder is in the closed position and carrying its normal load. Let us then suppose that sufficient overload comes on to operate the overcurrent relay 176, which will in turn cause the line contactor 172 and its auxiliary relay 172X to open. When the line contactor 172 is opened, the overcurrent relay automatically resets and the reclosing relay 182 provides a time element. At the end of this time element, auxiliary relay 182X closes and completes the circuit of the resistance-measuring coil of relay 182. The closing of relay 182X also completes the measuring-resistance circuit, thus sending a measuring current over the feeder to the fault or overload. The *A* and *B* coils of relay 182, acting upon a disk, oppose each other, and are able to measure the apparent resistance of the feeder circuit and indicate when the value rises to a safe point for reclosing the line contactor. As the feeder resistance is raised to a safe reclosing value, the action of the *B* coil overpowers that of the *A* coil and causes the reclosing relay to close its contacts as indicated by 182B. This operation completes the circuit of auxiliary relay 172X, which, upon closing, energizes the line-contactor operating coil, thereby reclosing the contactor and restoring service to the feeder.

Reclosing of the line contactor deenergizes auxiliary relay 182X. This relay, upon opening, inserts a resistance in the operating coil circuit of line contactor 172. The purpose of this resistance is to limit the operating coil current to the normal value for continuous operation. This scheme provides means of "over-shooting" the coil of contactor 172, thus obtaining a rapid closing action.

The selective control relay 183 provides means of reclosing the feeder equipment when either section 1 or section 2 of the trolley feeder is ener-



No.	Nomenclature
108	Control power switch
172	D.C. line contactor
172X	D.C. line contactor aux. relay
176	D.C. overcurrent relay
182	D.C. reclosing relay
182X	D.C. reclosing relay aux. device
183	Selective control relay

Schematic diagram of connections for new automatic reclosing feeder

gized. This relay merely transfers the control circuit to either section, depending upon which section is energized. The feeder may be opened and closed, manually, by the operation of the control power switch 108. This switch completely isolates the control circuit and measuring resistance from the power supply.

The construction of the steel-inclosed feeder equipment may be observed from the illustrations. The housing is made from ⅛-in. sheet steel with entirely welded construction. Expanded metal mesh and ⅛-in. sheet steel are used for the mounting and protection of the edgewound measuring resistance, located on top of the housing. Doors permit access to the housing from both sides and rear of the panel. Latches are provided for the doors and, if desired, the doors may be padlocked. Ebony asbestos lumber is used for the panel material on which the functioning apparatus is mounted. This panel is secured in the housing by angle-iron clips at both the bottom and top.

In the interior the housing is arranged in two compartments, the panel forming the partition. The rear compartment provides access to the rear of the panel for making cable connections. Openings for 2-in. conduit or cable are provided in the bottom of the compartment. The relays and contactors are mounted on the panel in the front compartment. The circuit interrupter is designed with an extended arc chute of ebony asbestos material. This arc chute extends to the exterior of the housing, thus providing for the dissipation of the arc and also for the escape of the conductive gases.

The complete equipment is arranged for mounting, either on a cross-arm or on a floor base, in either outdoor or underground applications.

The Equipment Review

Two newly designed machines have been introduced for welding work. One is the 300-amp. gas-engine-driven, single-operator, arc-welding set put out by Westinghouse. This set is intended for use for supplying welding current where a local power supply is not available. Complete, it consists of a model P-35 Continental 4-cylinder gas engine direct-connected to a new type Westinghouse 300-amp., single-operator, type SK, arc-welding generator, with a flexibly coupled exciter overhung from the generator bracket. The unit is designed to be as compact as possible. Another feature is that it is separately excited, resulting in simplified control and efficient operation. The engine has an S.A.E. rating of 28.9 hp. Fuel consumption is approximately 1½ gal. per hour.

The other machine is an improved so-called "Stable-Arc" welder turned out by the Lincoln Electric Company, Cleveland. Its outstanding feature is the unification of the controls of both motor and generator. The working mechanism of these controls is inclosed in a ventilated steel cabinet. Unified control increases the simplicity of operation. A combined voltmeter and ammeter is supplied, making it possible to read voltage and amperage on one dial.

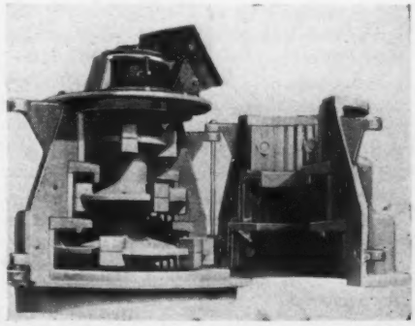
United Verde Orders New Hoist

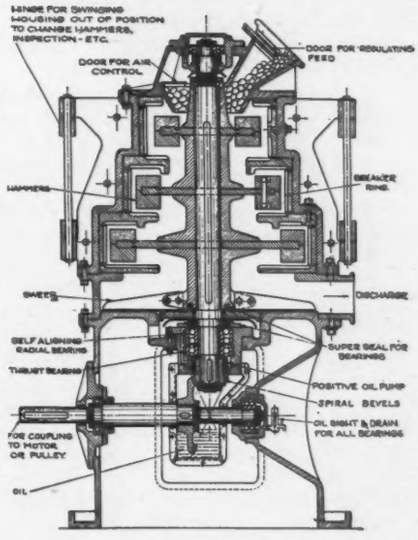
United Verde Copper Company has recently ordered hoist equipment for one of its mines. The hoist is a Nordberg double-drum unit with 12-ft. diameter drums and a 7-ft. face, direct-connected to a 2,700-hp. 650-volt, 66½ r.p.m. d.c. Westinghouse motor. The hoist is to be installed underground on the 1,000-ft. level. A two-compartment shaft is to be sunk below this point to a total depth of 4,253 ft. The hoist will handle skips holding 15,600 lb. of ore at a rope speed of 2,500 ft. per minute. Power will be supplied by a flywheel motor-generator set consisting of a 2,500-hp. a.c. motor (3 phase, 60-cycle, 6,600 volts, 680 r.p.m.) which will be direct-connected to a 10-ft. flywheel and two 1,250-kw., 650-volt d.c. generators and a 45-kw. 250-volt, 680-r.p.m. exciter. Ward Leonard control will be provided. This installation, it is said, will be the largest in the Southwest.

Hammer Pulverizer Has New Features

The impact-attrition pulverizer illustrated herewith possesses a heavy vertical chrome-nickel forged shaft,

Multiple-chamber hammer pulverizer





Vertical cross section of the pulverizer

which supports three steel disks, on which are firmly bolted heavy chrome-nickel alloy hammers. Each disk, with its set of hammers, revolves in its individual pulverizing chamber, which consists of a corrugated alloy breaker ring, concentric with the disk. Each chamber is separated from the adjoining chamber by corrugated ledge plates, both at the top and bottom.

A horizontal shaft transmits rotation to the vertical shaft through spiral bevel gears, the ratio of which may be made suitable for motor, turbine, or belt drive. The case is vertically split to insure accessibility. Bearings are self-aligning, with individual oil pumps.

Material up to 1½-in. size is fed in at the top of the machine and discharged in a uniformly pulverized state. Because of certain construction details, it is said that the pulverizer acts as a separator and holds back all material until it reaches the desired fineness.

The machine, known as the Whirlwind pulverizer, is manufactured by George F. Pettinos, 1206 Locust St., Philadelphia, Pa.

New Oil Switches

A new line of oil switches in capacities from 200 to 2,000 amp. and from 2,500 to 15,000 volts, with interrupting capacities from 20,000 to 40,000 kva., has been introduced recently by the Roller-Smith Company, 233 Broadway, New York. This is the first offering of the company in the oil switch field.

INDUSTRIAL NOTES

The Chicago office of the American Hoist & Derrick Company, which has been located at 1113 Fisher Building, has moved to 1,000 Engineering Building at 205 West Wacker Drive. The Pittsburgh branch is now at 901 Farmers Bank Building, instead of 604 Chamber of Commerce Building.

C. A. Higgins, manager of the development department, and C. C. Hoopes, treasurer, have been elected members of the executive committee of the Hercules Powder Company. C. D. Prickett, vice-president, has been elected a member of the finance committee.

A. M. Mueller has been appointed assistant secretary and member of the board of directors of Joseph T. Ryerson & Son, Inc. H. B. Ressler succeeds Mr. Mueller as general manager of sales. R. C. Ross is advanced from general traffic manager to assistant to the president in charge of plant operations.

Accompanied by his wife and son, E. J. Schwanhausser, assistant manager of the Harrison Works, Worthington Pump & Machinery Corporation, is taking a trip through Europe.

On and after June 1, the Cleveland office of the General Refractories Company will be located at 1,126 Leader Building, Cleveland, Ohio. The Buffalo address has also been changed to 1,210 Genesee Building, Buffalo, N. Y.

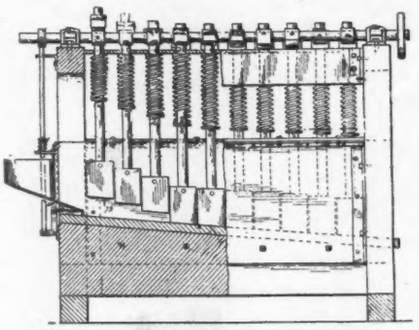
Fusion Welding Corporation, a subsidiary of the Chicago Steel & Wire Company, has taken over the sale of all welding rod manufactured by the parent company.

A merger of The Selden Company with American Cyanamid has been approved by the boards of directors of both companies, and will soon be submitted to their stockholders. No change in management is contemplated.

The Charles A. Coffin prize, awarded annually to that central station which has done most for the advancement of the electrical art, goes this year to the El Paso Electric Company, of El Paso, Tex. This award was established by the General Electric Company, in honor of its founder.

PATENTS

ORE PULVERIZER. No. 1,715,724. June 4, 1929. A. F. Thompson, Sunland, Calif.



A hammer-type of pulverizer.

FLOTATION REAGENT. No. 1,716,104. June 4, 1929. E. K. Bolton, assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.

Use of 1-mercapto benzo thiazole in the selective flotation of sulphide ores.

XANTHATE MIXTURE. No. 1,716,273. June 4, 1929. J. H. James, assignor to C. P. Byrnes, Sewickley, Pa.

A mixture of xanthates of the alcohols of higher molecular weight than amyl alcohols.

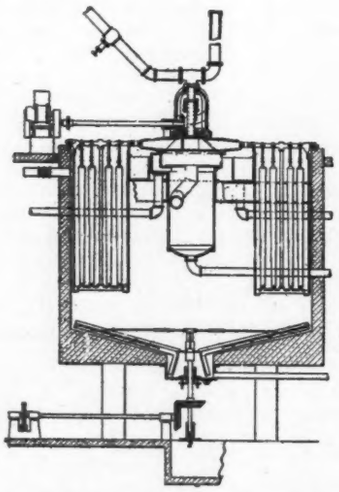
CLASSIFIER. No. 1,716,309. June 4, 1929. G. J. Fournier, Danville, Ill.

A hydraulic classifier equipped with a spraying device in each compartment.

GYRATORY CRUSHER. No. 1,716,342. June 4, 1929. J. S. Haas and R. Bernhard, assignors to Traylor Engineering and Manufacturing Company, Allentown, Pa.

Design for a seal forming an integral part of a gyratory crusher.

CONTINUOUS FILTER. No. 1,716,040. June 4, 1929. A. L. Genter, assignor to Genter Thickener Company.



Design for a continuous-filter thickening apparatus.

CONVEYOR. No. 1,718,941. July 2, 1929. G. Bockau, assignor to Ottumwa Iron Works, Ottumwa, Iowa.

A jigging conveyer which is oscillated by means of rollers.

ADAPTER FOR FUSES. No. 1,719,065. July 2, 1929. R. Mallet, assignor to Ensign Bickford Company, Simsbury, Conn.

An adapter for detonating fuses which consists of a block of compressed explosive material.

PRECIPITATION OF TIN. No. 1,714,667. May 28, 1929. H. Harris, London, England.

Method of preferential recovery of tin from a solution containing tin and arsenic. Calcareous matter is added as a precipitating agent for the tin, and a suitable carbon dioxide compound is introduced to prevent simultaneous precipitation of the arsenic.

REDUCTION OF METALLIC OXIDES. No. 1,714,767. May 28, 1929. A. J. F. J. Cousin, assignor to The Société Anonyme John Cockerill, Seraing, Belgium.

A process for reducing metallic oxides of relatively heavy non-volatile metals.

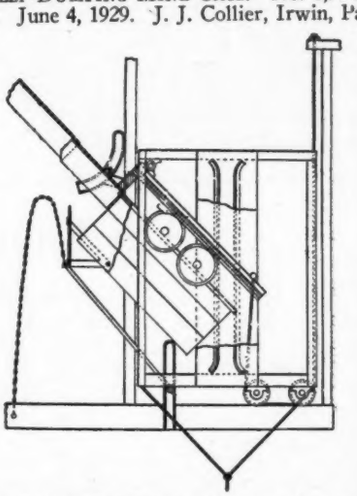
FACING FOR DRILLS. No. 17,323. June 11, 1929. Reissue. R. D. Davis, assignor to P. L. & M. Company, a corporation of California.

A process for forming a hard tungsten-carbon facing on the cutting edges of drilling tools.

SAFETY LAMP. No. 1,716,374. June 11, 1929. H. Fleissner, Leoben, Austria.

A miner's benzene safety lamp for indicating the presence of methane.

SELF-DUMPING MINE CAGE. No. 1,716,030. June 4, 1929. J. J. Collier, Irwin, Pa.



A method of automatically dumping mine cars by means of the movement of the car support about a pivot arranged along one side of the cage.

DI-AMMONIUM PHOSPHATE. No. 1,716,415. June 11, 1929. G. H. Buchanan, assignor to American Cyanamid Company, New York, N. Y.

Method of making di-ammonium phosphate which depends on the reaction of a solution of acid phosphatic material with ammonia.

ZINC PRODUCT. No. 1,716,599. June 11, 1929. W. M. Peirce and E. A. Anderson, assignors to The New Jersey Zinc Company, New York, N. Y.

A mechanically worked zinc product made of a zinc base alloy substantially free of aluminum and containing not less than 92 per cent of zinc, from 0.005 to 0.5 per cent of magnesium, and from 0.05 to 5 per cent of copper.

OIL SHALE. No. 1,716,667. June 11, 1929. A. Schilling and R. Sachse, San Francisco, and D. Liamin, Los Angeles, and T. Callaert, San Francisco, Calif.

A process of producing water gas and extracting oil from oil shale.

CAP. No. 1,716,719. June 11, 1929. R. E. Christopher, Grindstone, Pa.

A cap equipped with an eye protector hinged below the visor. The protector can be raised or lowered as desired.

NEWS OF THE WEEK

Summary

CHRISTMAS COPPER has started operations at its new concentrator in the Ray district. Capacity of the mill is 400 tons a day. Shipments are made to the Hayden smelter. Page 148.

* * *

Commerce Mining & Royalty has ordered a 3,750-hp. Nordberg Diesel engine for its power plant at Cardin, Okla. Total capacity of the plant will be 10,500 hp. Page 150.

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N'Changa Copper will probably use caving methods for extraction of the mixed sulphide and oxide ores of the Dambo Lode, in Northern Rhodesia. Résumé of operations and summary of drilling results at N'Changa. Page 153.

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Consolidated Mining & Smelting abandons exploratory work at Rotten Stone Lake, northern Manitoba. Reported discoveries in this district excited interest last fall. Page 149.

* * *

Calumet & Arizona appropriates $2,133,000 for modernization of Junction shaft and Douglas smelter plants. New electric hoist at Junction shaft will be able to hoist from 4,500 ft. Page 147.

* * *

Construction of the 30,000-ton electrolytic copper plant of Union Minière, at Panda, Belgian Congo, is progressing rapidly. Plant is expected to be in operation by end of the year. Page 151.

* * *

Electric Bond & Share has acquired power holdings in Durango, and may construct a new power plant for mining enterprises in that district. Other Mexican notes. Page 152.

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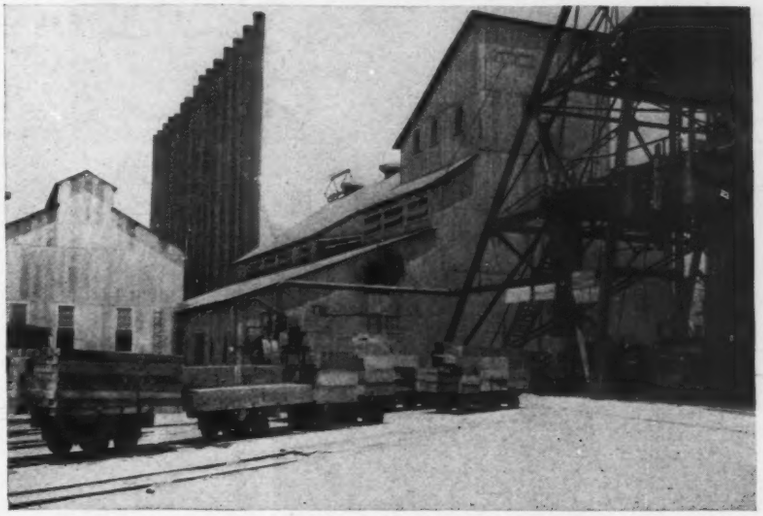
Rapid progress in exploratory and construction work is reported from Howey Gold, in northern Ontario. Three camps are at work clearing the power line. Page 150.



Surface plant at Calumet & Arizona's Junction mine, which will be remodeled and electrified, in company's new construction program

C. & A. Appropriates $2,133,000 for Improvements at Smelter and Mine

New Reverberatory, Converter and Boiler Plants to Be Built at Douglas Reduction Works and Complete Electrification of Equipment at Shaft Undertaken—May Sink to 4,500 Ft.

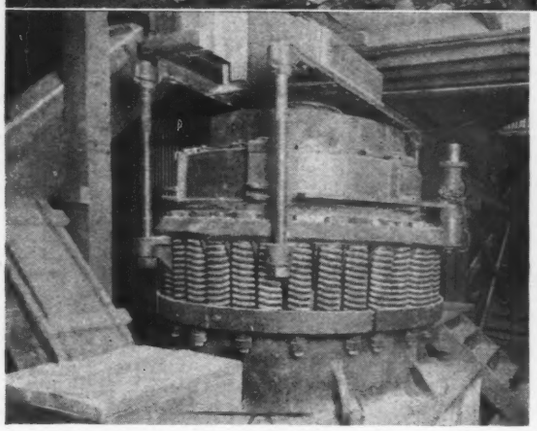
CALUMET & ARIZONA has announced the appropriation of $2,133,000 for the modernization and enlargement of two of the most important units of its properties in the Bisbee district. The Douglas smelter will have a complete new reverberatory plant and other construction which will bring it up to date. Electrification of all equipment and installation of a new hoist of considerably increased depth comprise the program at the company's Junction shaft.

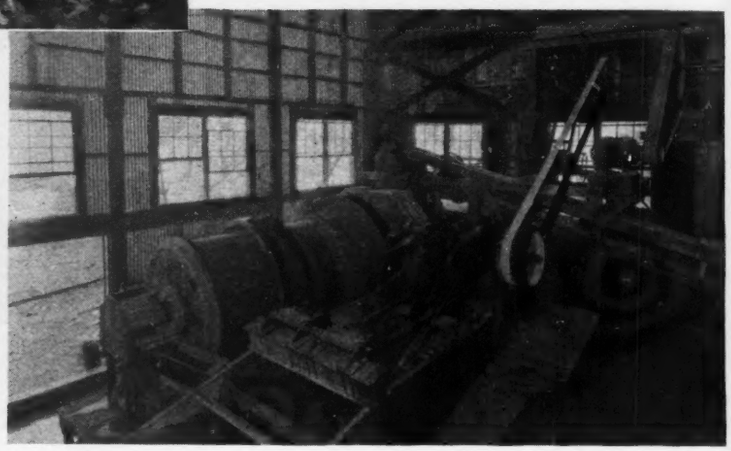
A total of $1,600,000 will be expended at Douglas. Besides the new reverberatory plant, plans call for a new charging and skimming track; a new boiler plant; a new converter plant; and additional power units. The five reverberatory furnaces now in operation at Douglas smelted 797,341 tons of ore and concentrate during 1928. In connection with these improvements, it may be interesting to note that Phelps Dodge also recently announced a proposed expenditure of $1,000,000 for new anode-casting and other equipment at its Copper Queen smelter, also at Douglas.

At the Junction shaft, an electric hoist will replace the old steam hoist, which has long handled all the ore from the entire C. & A. territory. This new hoist will be able to operate from a depth of 4,500 ft., which is considerably deeper than any present operation in the Bisbee district. The electric hoist now being installed at the Campbell shaft can hoist from a depth of only 2,500 ft., which is 300 ft. deeper than any operating level in Bisbee. The new Junction hoist will thus be sufficient for development well into the future.

Auxiliary equipment will be installed, including two new electric air compressors, each with a capacity of 4,400 cu.ft.; two water-tube boilers of 750 hp., to be built by the Combustion Engineering Corporation; and one 750-kw. steam turbine, with cooling towers. Total expenditure at the Junction shaft will be $533,000.

At its New Cornelia mines, Ajo, Ariz., Calumet & Arizona is spending $3,200,000 for new equipment for the enlargement and modernization of concentrator, power plant, and mines.





Left—The new mill of Christmas Copper in the Ray district of Arizona. Below, left—No. 4 Symons cone crusher at the Christmas mill. Below, right—Ball mill and Dorr classifier at the new plant.

Christmas Copper Starts Operations at New 400-Ton Concentrator

By A. J. McDermid
Special Arizona Correspondent

THE new concentrator of Christmas Copper at Christmas, Ariz., in the Ray district, has been in operation since the latter part of June. Construction of the plant was by the Southwestern Engineering Company. The mill has a capacity of 400 tons daily, and is shipping the concentrate to the Hayden smelter.

Ore is delivered to the mill in one-ton cars, which are hauled from the mine by storage-battery motors, and dumped into a 400-ton coarse-ore bin. From the bin the ore is fed by a pan conveyor, governed by Reeves variable-speed transmission, to a conveyor belt leading to a No. 6 Telsmith gyratory, which crushes it to 3 in.

The crusher is driven by a 40-hp. Westinghouse induction motor, operating at 440 volts. As the next step the ore is reduced to $\frac{5}{8}$ in. in a No. 4 Symons cone crusher, driven by a 100-hp. induction motor. The Telsmith was part of the old Iron Cap mill at Copper Hill, but the Symons is a new machine.

The Iron Cap and Christmas properties are controlled by the same interests. As the ore at Iron Cap is exhausted, no further use was seen for the mill at Copper Hill, and it was partly dismantled and much of the machinery moved to Christmas. All major apparatus at the Christmas mill, however, except the Telsmith crusher and the ball mills, appears to be new.

From the Symons crusher the ore is carried by an inclined conveyor belt to the top of a 500-ton cylindrical fine-ore bin, of steel construction. As the ore passes into the bin it is automatically sampled by a Southwestern Engineering sampler. From the fine-ore bin the ore passes to two 5 x 10-ft. ball mills, which were rod mills in the Iron Cap mill, but which have been converted into ball grinding mills. They operate in closed circuits with two Dorr classifiers. A 25-hp. induction motor drives the two classifiers and the feeder from the fine-ore bin. Two 100-hp. Westinghouse induction motors drive the two ball mills. The overflow from the classifiers goes to a conditioner, which is a cylindrical tank containing an impeller. In this tank xanthate and pine oil are added to the pulp. Lime is added in powdered form to the ore as it passes from the fine-ore bin to the ball mills.

The flotation section of the mill contains four Southwestern Engineering air cells, two of which are used as roughers and two as cleaners. At present the pulp goes from the conditioner to the No. 1 rougher cell, from which the overflow goes to the No. 2 rougher cell and the tailing to the waste dump. From the No. 2 rougher the overflow goes to the No. 1 cleaner and the tailing to waste. Overflow from the No. 1 cleaner goes to the No. 2 cleaner and the tailing to waste. Overflow from the No. 2 cleaner goes to the filter plant, which is on the railroad about a mile from the mill. The tailing from the No. 2 cleaner goes to the conditioner. A 50-hp. Westinghouse induction motor drives a Connersville blower supplying the air for the flotation cells at 1.5 lb. pressure. The blower has a displacement of 24 cu.ft. per revolution. Two No. 4 Wilfley centrifugal sand pumps, driven by two 15-hp. induction motors, are used to elevate the pulp. At the time this article was written, the mill had not been tuned up to its best operating efficiency, and it is probable that some changes in the flow sheet may be necessary. It is also not yet possible to obtain representative figures on grade of concentrate and tailing, percentages of reagents, and other metallurgical data.

With present grinding equipment mill capacity is about 400 tons per day. Space is provided for another ball mill; if this is installed the capacity will be increased to 600 tons. The concentrate is shipped to the Hayden smelter, and the company also ships about 100 tons of ore per day of the same grade as that sent to the mill (about 2 per cent). This ore is not concentrated, because the limestone gangue is needed by the smelter as a flux. The ore is sent from the shaft collar to the railroad by a gravity-operated cable tramway.

The ore at Christmas occurs as contact deposits in flat-lying limestone beds that have been intruded by quartz diorite. A profusion of small garnet

crystals accompanies the ore minerals, bornite and chalcopyrite, and serves as a marker for them.

Mill and camp lie about one mile west of the Gila River and about 700 ft. above it. The shaft collar and upper tramway terminal are several hundred feet higher up the hill than is the mill. All the levels in the mine connect with the surface. A new power plant has been erected at the river near the filter plant and the lower tramway terminal. It consists at present of two 450-hp. Chicago Pneumatic Diesel engines, and the foundation for a third has been laid. Each engine is directly connected to a 300-kw., 60-cycle General Electric generator and a 12-kw. General Electric direct-current generator, both mounted on the same shaft. The alternating-current generators operate at 1,300 volts, and the other two at 125 volts. Engines and generators turn at 257 r.p.m. The new plant, at present delivering about 800 hp., supplies power for the entire operations. The company formerly purchased its power from the Hayden smelter, and this power is still available in case of emergency.

Christmas is at present employing about 150 men, but this number will be increased as soon as the mill is able to take its full quota of ore regularly. Several dwellings are being built to accommodate the increased operating force. Water is pumped to the camp from two 150-ft. wells cased with 18-in. pipe on the Gila River. The water comes mainly from seepage through the Coolidge dam.

H. A. Rosselle is general manager of the property. Frank P. Knight, Jr., is mill superintendent, and Sam Hendricks is chief mine engineer.

Phosphate Producers Urge Ban on Convict-Mined Rock

On behalf of domestic phosphate producers, L. R. Mason, of New York, appeared before the Senate Finance Committee on July 16 to urge tighter restrictions against imports of rock mined by convict labor in Morocco. The present law bans goods manufactured by convicts, but does not apply to commodities grown or mined. Mr. Mason wants Section 307 broadened to cover the basic industries of mining and agriculture. Inasmuch as imports of phosphate are minute as compared to exports, there was some comment on the part of committee members against the proposal.

Gold Hill Suspends Operation

Operations at the Gold Hill mine, in the Boston Creek section of the Kirkland Lake district, have been suspended. Recent drifting on the 1,100 level showed that the main vein had widened from a few inches on the upper levels to 5 or 6 ft. in places, but the results were not considered sufficient to justify continuation of operations in that direction.

Consolidated M. & S. Stops Work at Rotten Stone Lake

CONSOLIDATED Mining & Smelting has stopped work on the Hall properties, at Rotten Stone Lake in northern Saskatchewan, which it has had under option for some time, according to advices received at Toronto. Unfavorable results from the diamond drilling which has been carried on since last winter are believed to be responsible for the decision. The properties lie 260 miles from transportation. During last winter diamond drills were taken in and a large amount of drilling has been done since that time.

Rotten Stone Lake created a good deal of interest last fall following the discovery of a large outcrop containing nickel and copper and giving substantial assays in metals of the platinum group. Ventures, Ltd., owns a large acreage adjoining the Consolidated.

Great Northern Drilling Fails to Prove Ore

DRILLING by Great Northern Iron Ore on land held under option in Aitkin County, Minn., has thus far yielded only negative results. The final showing in each of six holes drilled to an average of 225 ft. has been pulverized slate.

Two more holes will be started in a few days, and some of the first six will be drilled further. Preliminary exploration on the optioned properties of 70,000 acres, in Aitkin and Crow Wing counties, will consist of a minimum of 25 holes. Further operations will depend on the indications uncovered. Progress has been slow because the country is rough and overgrown with heavy brush.

Civil Service Has Positions for Two Metallurgists

The Civil Service Commission, Washington, D. C., is receiving applications for the positions of associate metallurgist and assistant metallurgist, to fill vacancies in the departmental service and the federal classified service. Applications must be on file before Aug. 28. Entrance salary is $3,200 a year for the associate grade, and $2,600 a year for the assistant grade. Full information as to the examination and duties may be obtained from the Commission, or from the secretary of the U. S. Civil Service Board of Examiners at the post office or custom house in any city.

Leviathan to Ship Ore

The Leviathan mine, near Markleeville, Alpine County, Calif., has been acquired by the newly organized Bluestone Copper Company. After being idle for many years, the mine is now in position to make a shipment of high-grade carbonate ore within a few days. G. C. Kane is manager.

Three Companies to Merge for Radium Production

PROJECTED development of radium ore deposits in Cornwall, South Australia, and Czechoslovakia is involved in the merger of three interested companies, according to *Chemical Trade Journal*. These are Radium Ore Mines, Ltd., owning mines and properties in Cornwall; Australian Radium Corporation, owning the rich radium-bearing lodes identified in the Mount Painter district by Australian government and Adelaide University geologists; and Radium Syndicate, Ltd., which has connections in Czechoslovakia.

Radium-bearing uranium ores from Weipert, Czechoslovakia, are to be sent to the Cornwall works for refining. The syndicate has also negotiated with the government of Czechoslovakia for selling rights for radium produced by the government mines at Joachimov. The new organization is expected to facilitate commercial production of radium. Lack of capital has prevented exploitation of some of the properties involved.

Osisko, Noranda Neighbor, Will Resume Operations

Operations will be resumed immediately on the Osisko property, in the Rouyn district of northern Quebec, which were suspended to await the results of development on the adjoining Noranda property. The new ore located to the east of the diabase dike at Noranda, and other favorable developments, have resulted in plans for starting work sooner than had been expected.

A crib is to be constructed in the lake and a detailed program of diamond drilling will be carried out. As Noranda is heavily interested in the company the lower horizons of the Osisko may later be opened up from the Noranda workings.

Depth Development Continues at Calumet & Hecla

At Calumet & Hecla, in the Michigan copper district, the conglomerate bed is being opened at great depth, the haulage level at the 81 and the electric hoists at that elevation making this possible. The 92 level of "C" shaft at the Calumet or north end has been driven into Tamarack ground and eventually will be extended below and beyond Tamarack Junior. "A" shaft at the Hecla or south end has been connected with "C" by the holing through of the 91 level. Sinking is in progress in "A," which is now bottomed on the 91 level.

Belmont Installs Pump

Installation of an additional large pump will enable Belmont Mining, in the Superior district of Arizona, to resume operations on the 1,450 level. Flooding recently held up work at that depth.

Ontario Mines Department Maps Sudbury District

THE Department of Mines of Ontario is continuing this Summer the task, started last year, of assembling accurate and detailed geological information about the Sudbury mining area. Part of the work, under the direction of A. G. Burrows, chief geologist, and A. C. Rickaby, of the geological staff, is to map important sections of the district in detail, using Dr. A. P. Coleman's map as a base. Dr. Coleman's map is widely used and reveals with remarkable accuracy general geological features on a scale of 1 mile to the inch. The maps now being prepared will reveal considerably more detail, using a scale of 400 ft. to the inch.

Last year the government's geological work was confined principally to an investigation of the sedimentary rocks in the center of the basin area, which at that time were under exploration by several companies for occurrences of lead-zinc-copper ore deposits similar to those under development by Treadwell-Yukon at Vermilion Lake. This year's survey and mapping are being concentrated on the more important sections of the great masses of norite and micropegmatite eruptive which form the rim of the basin and with which are associated the known deposits of nickel-copper ore such as the Frood, Creighton, Levack, Garson, and Falconbridge mines. The program includes a detailed geological study of the surface of the Frood offset, the Falconbridge Nickel mine, the Foy offset where Sudbury Offsets, Ltd., is operating, and the Worthington offset, where several companies are engaged in exploratory drilling on what are believed to be extensions of the Worthington deposit.

Wilbur Proposes Transferring Government Lands to States

THE political West is astir over the proposal of Secretary Wilbur of the Interior Department to turn over unreserved government lands to the states. This would involve a total area as large as all of New England and the Atlantic seaboard states down through North Carolina. For many years each Congress has seen a bill to the same effect tabled in committee, but this is the first approach from an executive source. Many of the Western states will jump at the opportunity and already are proposing to discuss the matter in conferences soon to be held between governors and other officials.

Mr. Wilbur's belief is, that if the Western states are to reach full statehood, they should take problems into their own hands rather than await benefits forthcoming in cautious doles from a paternalistic government at Washington.

Mineral resources are secondary in the Secretary's mind. He views agriculture as the basic industry of the West and declares that true conservation must undertake to save watersheds against the ravages of over-grazing and deforestation, with their attendant soil and run-off depletion. Many think, however, that the time has not come for local politics to be given a free hand in problems that must be met irrespective of arbitrary boundary lines.

Mine and Plant Development Proceeds at Howey Gold

SHAFT SINKING has been halted and a sump completed 35 ft. below the 1,000-ft. level at Howey Gold, in northern Ontario. Ore pockets are now being cut at the 500 and 1,000 levels, and after this is done four new levels at 125-ft. intervals between the 500 and 1,000 horizons will be opened.

Progress is also reported on preparations for bringing the mine into production; concrete has been poured for the foundations of the crushing plant, forms have been built for the ore bins, and all rock excavation work has been completed on the site of the new mill. Construction of the power line from Ear Falls has also started, three camps having been established by Morrow and Beatty, contractors. One is at Ear Falls, another at Chukuni River, and the third at Pugwash Lake.

Colorado Mining Suffers Through Lack of Smelters

COLORADO might regain her preeminence in mining if vision would be applied to the extraction and reduction of the state's immense reserves of low-grade ores, says John T. Joyce, Commissioner of Mines, in his annual report. According to statistics compiled by federal and state geological surveys, the mining fields of Colorado contain over 25,000 square miles of highly mineralized lands; the state's total mineral production of over $1,600,000,000 has come from districts embracing only 2,000 square miles.

Lack of one or more complete reduction plants employing modern metallurgical practice, and not the mines, is responsible for present unsatisfactory conditions, according to the report. The only smelters in the state are those at Leadville and Durango, both far from some of the state's prolific districts. Hence they cannot treat low-grade ores at a profit. The Tooele smelter of International Smelting and the Midvale plant of U. S. Smelting, Refining & Mining are cited as examples of how modern reduction plants can reorganize the entire mining industry in a state where conditions are intrinsically no more favorable than in Colorado. A plant could be erected in Denver at a cost of less than $2,000,000 that would re-establish Colorado mining, thinks Mr. Joyce.

Colorado produced $16,053,944 of gold, silver, lead, zinc, and copper in 1928, as compared with $16,965,162 in 1927. Valuable amounts of molybdenum and vanadium also were mined.

Commerce M. & R. to Install 3,750-Hp. Diesel Engine

COMMERCE MINING & ROYALTY will have one of the largest Diesel power plants in the country at Cardin, Okla., after the installation of an additional 3,750-hp. Nordberg unit which has just been ordered. Combined capacity of the four engines in the plant will then be 10,500 hp. The new unit will have six power cylinders and will drive a 3,250-kva. generator.

A contract for more than 50,000 tons of steel has also been let by Commerce in connection with the building of a new all-steel mill on its Bird Dog lease, west of Picher. As the Bird Dog lease covers several individual allotments on restricted lands, a novel method of handling the ore has been planned. Four separate steel hoppers will be constructed at the mill. Ores from certain allotments will be automatically weighed and sampled as dumped into these hoppers and a tailing sample will give the proportionate division of the zinc and lead produced to the several Indian owners. A belt conveyor will be run between the four hoppers to carry the ore to the crushing plant.

The new all-steel mill of the company, just completed on the Paxson lease, three miles west of Baxter Springs, has been placed in operation. This is one of the largest mills in the district. It will handle approximately 100 tons of ore an hour.

Canam Gives Up Options on Cortez-King Brand

THE political West is astir over the held on the properties of Cortez-King Brand Mines, in the Tri-State district, has been relinquished. The properties were optioned to the Canam company about two months ago, the price stipulation being $900,000. Canam recently purchased the two properties of the Golden Hawk Mining for a consideration said to be in excess of $250,000. It entered the Tri-State district in January, with the purchase of the five mines of Childress Lead & Zinc for $1,000,000. Since then the company has purchased the Foch mine from Evans-Wallower and Eagle-Picher Lead, the Crystal mine, and the McWhite mine. It is now the seventh largest producer in the district.

Eagle-Picher Orders Steel for Smelter Improvement

Contracts for about 75,000 tons of steel have been awarded by Eagle-Picher Lead for use in its improvement program at its Galena lead smelter, in the Tri-State district. A Dwight-Lloyd sintering machine will be added to the plant and all of the pilot plants and smelting equipment now used at the Smelter Hill plant in Joplin will be moved to the Galena plant.

Union Minière Construction Makes Rapid Progress

THE LEACHING and electrolytic precipitation plant of Union Minière du Haut-Katanga, at Panda, Belgian Congo, is expected to be in operation by the end of the year. The plant will have a yearly output of 30,000 metric tons of electrolytic copper. Completion of the smelting plant has enabled the entire construction force to concentrate on the new plant.

Other developments of Union Minière include sinking shafts at the Prince Leopold mine; enlarging the Lubumbashi power plant; installing a system of radio communication between the principal mines and the central stations, Lubumbashi and Panda; building houses for the European personnel at Panda; and improvement of the quarters and hospitals for the workers.

With the extension of the railroad into the Musonoi-Kolwezi-Ruwe region, development work in this western region has been speeded up. Preparatory studies have been made for opening the mines and harnessing the waterfalls of the Lualaba River, so that actual mining operations may begin as soon as the railroad is completed.

Extraction of copper-bearing ore from the various mines of Union Minière in 1928 was as follows: Ruashi, 410,000 metric tons; Likasi-Chituru, 41,000 tons; Kambove, West Kambove, and M'Sesa, 582,000 tons; Prince Leopold, 193,000 tons; Luushia, 639,000 tons; and Lukuni, 46,000 tons; a total of 1,911,000 tons of ore. From this was produced 112,456 metric tons of blister copper, as contrasted with 89,155 tons in 1927, and a previous high, in 1925, of 90,194 tons. The present year will probably again make a record. Production for the first six months, compared with the corresponding months of last year, follows:

	1929	1928
	Tons	
Jan.	9,000	9,767
Feb.	8,600	8,703
March	10,800	9,953
April	11,700	10,200
May	12,000	10,474
June	11,800	8,508

United Gold Develops New Ground

Laterals will soon be run and extensive development carried on in additional ground recently purchased by United Gold, in the Cripple Creek district of Colorado. The new ground adjoins the Vindicator property and covers vein systems in which a strike was made on the sixth level.

Progress Made at Calaveras

Development at the Calaveras County property of Engels Copper, at Copperopolis, Calif., which was acquired from Calaveras Mining early in June, is progressing. It is hoped that by August test runs of 200 tons a day will be made, which will gradually be stepped up to 500 tons a day by the end of the year.

Chilean Mining Bank to Build Copper Smelter

CONSTRUCTION of a new copper smelter at Paípote has been approved by the Caja de Crédito Minero of Chile, formed recently by the Chilean government to aid in development of small mining properties. German experts will supervise the building of the new plant, which will have two furnaces with capacity of 250 tons daily each. In addition the organization will build three new flotation plants, each with a capacity of 100 tons, at Chañaral, Copiapó, and Coquimbo. All of the new plants will be operated by the Caja.

Proposed New Mining Act May Affect Ontario Producers

MINE operators in Ontario are seriously concerned over the new mining act. The policy of operations for every mine will have to be changed considerably if the act is passed as now proposed. The principal objection raised is to the clause specifying that two mine outlets shall be provided, which it is claimed would seriously retard development in the prospect stage and affect present producers.

Mining men point out that the Kirkland Lake Gold mine, the deepest in the province, would suffer serious financial loss from the delay and expenditure involved in the sinking of another shaft to a depth of 3,600 ft. Other mines would suffer proportionally. If the clause is passed, some arrangements may possibly be made whereby one mine can connect its underground workings with those of the adjoining property.

McCrea Promises Research on Ontario Iron Problems

ONE of the first duties of the Research Bureau recently organized by the Ontario government will be to seek a program for the development of the province's iron resources, announced Charles McCrea, Minister of Mines, in a recent address at Fort William. Although gold mining has attracted most attention in Ontario, its iron-ore reserves may prove to be of great importance. Mr. McCrea pointed out that of the Pre-Cambrian shield, which includes the tremendous iron deposits of the Mesabi range, only 5 per cent is in the United States; the remainder is in Canada.

In addition to the Research Bureau, which will develop theories in relation to iron-ore problems, the government is aiding mining by sending six geological parties into northern Ontario this summer. Within five years, Mr. McCrea predicted, Ontario will have doubled its mineral production to more than $200,000,000.

Consolidated M. & S. Options Two Abandoned Alaska Mines

JOHN KOHL, of Ketchikan, Alaska, has given an option on the Rush-Brown and the Saltchuck mine, at the head of Kassan Bay, Prince of Wales Island, Alaska, to Consolidated Mining & Smelting. Between 1917 and 1920 a considerable tonnage of ore was shipped from Rush-Brown, but the mine was closed when the price of copper dropped, and has been idle since.

The Saltchuck property was operated for a time by J. C. Chilberg, of Seattle, and a concentrator was erected. The concentrate, which contained, besides copper and gold, a high palladium content, was shipped to New Jersey for treatment, but high treatment charges and excessive freight rates are said to have killed the enterprise.

Consolidated has a crew of men on both properties. It is laying a 7,000-ft. air line from the Saltchuck to the Rush-Brown, preparatory to unwatering the latter.

Champion Mill Revises Flow Sheet of Operations

WITH the introduction of the Fahrenwald flotation process, revision of the flow sheet in the Champion mill of Copper Range, in the Michigan district, has been necessary. After experimental tests, the following changes have been made:

Tables have been substituted for jigs; and Dorr classifiers instead of hydraulic will be used for the removal of the fine sand and slime, which will go direct to flotation. Slime was formerly lost in the tank overflows. Coarse sand will go to grinding mills, with classifiers in closed circuit. The classifier product will go to flotation with the other sand. A concentrated product from the flotation tailing will be put over the tables, to catch any copper that may have been lost during flotation. The new cycle is expected greatly to increase extraction.

Amulet Picks Mill Site at Rouyn

The site for the new mill of the Amulet Mine at Rouyn, Que., has been decided upon. It will be situated 1,500 ft. north of the shaft. The site is on a hillside, and, if considered advisable, the 75-ft. level may be driven through to the surface and ore may be trammed direct to the mill bins.

Arrangements for re-financing of the company have been practically completed; 500,000 treasury shares will be issued at $1 a share. They will be first offered to the general body of shareholders, but there will also be a syndicate undertaking to buy any unsubscribed shares.

Negotiations with the Canadian National Railway for a spur line are proceeding and some definite arrangement is expected soon.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Kirkland Lake Production May Soon Pass Porcupine at Present Rate

TORONTO, July 20, 1929—The Ontario Department of Mines figures for the gold production of northern Ontario for June show that 318,728 tons was treated, with a recovery of $2,888,288, or an average of $9.08 a ton. The Porcupine mines treated 232,231 tons and recovered $1,529,598, an average of $6.60 a ton and a decrease of $158,000 in the total production as compared with the previous month. This deficiency, however, was more than offset by an increase of $200,000 in Kirkland Lake production. The mines of this camp treated 86,497 tons and recovered $1,358,690, an average of $15.70 a ton. This represents the highest monthly production in the history of the camp to date. In a comparatively short time, output will again be stepped up, and it now seems certain that the output of Kirkland Lake will soon surpass that of Porcupine.

THE Teck-Hughes mine, at Kirkland Lake, is continuing four drifts in ore on the No. 25 level at 3,000 ft., but little more is known about widths than was given in the reports of the first crosscut, which showed two sections, one of 22 and the other of 6 ft. The third crosscut to reach the ore is on the 21 level, where conditions are the same as on Nos. 19 and 20. On the latter level, recent drifting has shown ore of very high grade.

The fiscal year for Lake Shore closed on June 30. The annual report, now in course of preparation, is expected to show ore reserves of approximately $100,000,000 gross. This is the largest amount ever shown by any Canadian gold mine. Estimates for ore reserves include the ground down to the 1,800 level only; when it is considered that the Teck-Hughes property adjoining is opening up high-grade ore at a depth of 3,000 ft., and that Kirkland Lake Gold has good ore on the 3,600 level, the possibilities of the property can be more readily understood. Recently, Lake Shore cut the north vein on the 2,000 level, with results comparing favorably with those obtained on the upper levels. A start has already been made on the additions to the mill in preparation for the enlarged capacity of 2,000 tons a day.

Results of underground development of the Mandy mine, in northern Manitoba, have not been satisfactory; patches of good-grade material have been encountered on three levels—625, 825, and 1,025—but they are too small to be considered other than junore. The company still has a considerable tonnage of zinc-copper ore remaining in the large rich shoot mined some years ago. Mandy was financed to the extent of $700,000 and has about $100,000 left.

Diamond drilling on the Central Patricia property, at Crow River, Ont., continues to give good results. The last hole shows three sections of ore. These sections were at a vertical depth of about 250 ft. Diamond drilling is to be continued, but the company now believes that sufficient information has been obtained to justify installation of a mining plant next winter.

Results from diamond drilling of a group of claims held by Nipissing Mining at Vamp Lake, Man., were not encouraging, and the option was dropped, but surface exploration is now under way on a group of 22 claims at Pickle Lake.

The T. & N. O. Railway report of shipments from Cobalt, Ont., during May shows a total of 326 tons, of which 228 tons was shipped to plants in Canada and 97 tons to plants in the United States. One interesting feature of this report is that shipments were made by five properties under lease. Though leasing is by no means a new development in Cobalt, shipments from as many as five of the old closed-down properties during any one month are rare. Leases have recently been granted on two other properties—the Temiskaming and the La Rose.

Diver Seeks Gold Sunk 28 Years Ago

H. FINCH, a diver of Seattle, is attempting to recover the safe of the "Islander," which ran into an iceberg and sank off Douglas Island, Alaska, 28 years ago. The safe is reported to contain several hundreds of thousands of dollars' worth of gold dust. Mr. Finch believes he has located the safe beneath 272 ft. of water.

Northern Arizona Miners Meet at Prescott, Aug. 24-25

A "mining revival" meeting for Yavapai County and northern Arizona will be held at Prescott, Aug. 24-25, according to present plans. The meeting is sponsored by the Yavapai County Chamber of Commerce, in co-operation with the Arizona Industrial Congress, the Arizona chapter of the American Mining Congress, and the Arizona section of the A.I.M.E. To encourage mining development by fostering discussion of problems is the purpose of the meeting. The sessions are particularly intended for prospectors, small operators, and men engaged in developing new properties. George G. Thomas, of Bagdad Copper; W. V. DeCamp, of United Verde; G. D. French, of Sheldon Copper; R. H. Dickson, of Verde Central; and W. J. Loring, of Arizona Metals, constitute the committee in charge of arrangements.

Mexico City Letter

BY W. L. VAIL
Special Correspondent

American Utilities Company Plans Power Plant Near Durango Mining Centers

MEXICO CITY, July 15, 1929—One of the latest acquisitions in Mexico of the Electric Bond & Share Company, of New York, is the electric system in Durango. According to report the company proposes to spend $4,000,000 in construction of a hydro-electric plant at Mezquital, in that state. Transmission lines will connect the city of Durango with mining districts within a radius of 150 miles. The present plant at Durango will also be enlarged. Entrance of Electric Bond & Share into northwestern Mexico, if accomplished, means a considerable stimulus to mining operations in that part of the republic. Camps like Guanacevi, which have been idle for years, largely because of lack of fuel or power, are expected to come forward rapidly.

THE Supreme Court has decided a protracted litigation regarding the ownership of the old Rey de Plata mines, in the State of Guerrero, in favor of the original claimants, Hofley Woolrich and associates. During the revolution this property was seized by an existing government and divided among several military chiefs. Plans have been presented for a 50-ton flotation mill. Evidently the owners plan starting production as soon as possible.

The Florencia Anexas mine, in Chihuahua, which has been operated for several years by the former Governor of the State, General Marcelo Caraveo, and which was confiscated because of the Governor's participation in the recent military coup, will be put up for lease to the highest responsible bidder or turned over to a co-operative organization of working miners, according to the local press. The latter proposition is said to be favored by President Portes Gil if a workable plan can be prepared.

Bobby Anderson Takes Over Reed Gold Property

Bobby Anderson Mining, operating in the Coeur d'Alene district, has taken a perpetual lease on the Reed property of eight patented claims, near Home, Ore. The property has been inoperative for 23 years. Before that, extraction of high-grade gold ore yielded over a million dollars to its owner, Mr. Reed, of Portland.

Bobby Anderson will mine the low-grade ore. The property has been opened by 5,000 ft. of workings. Retimbering the 3,200-ft. tunnel is now under way, and stoping will be started soon. John Jordan is in charge.

N'Changa Will Probably Mine Its Rich Dambo Lode by Caving Methods

SUBJECT to effective draining of the syncline in the vicinity of mining operations, the Dambo lode orebodies, now developed at N'Changa Copper, in Northern Rhodesia, can be mined to best advantage, in the opinion of the manager, by an adaptation of the caving method. If selective mining of sulphide and oxide ore in the River lode is not decided upon, this deposit may possibly be caved also. Caving, in addition to yielding ore at a low cost per ton, should suit the Central African labor and timber conditions better than other methods of underground mining.

Drilling is gradually revealing the extent of the new discovery on the Dambo lode. Results of 1928 prospecting are tabulated herewith and shafts and boreholes are shown on the accompanying map. The block delimited by drillholes B-12, B-15, B-14, B-17, B-13, B-11, and B-8 is estimated as follows:

Minimum Mining Grade Accepted, per Cent	Tonnage	Average Grade—Total Copper, per Cent	Average Grade—Sulphide Copper, per Cent
(a) 2	20,356,000	3.98	1.16
or (b)	21,551,000	3.87	1.11
or (c)	22,216,000	3.85	1.08
2.5	15,964,000	4.44	1.31

The three options above are governed by optional interpretations shown in the table for drillhole B-12.

From drilling in near-by Rhodesian Congo Border ground, this block is known to extend to the western boundary of N'Changa. Probably it also extends in other directions. Reserves at the property are placed in the annual report at 31,000,000 tons of 3.85 per cent ore.

Dambo lode ore developed to date consists of mixed oxides and sulphides. The 50 and 150 levels of the River lode also have opened mixed ore, but the 300 level shows relatively clean sulphides, with localized oxidation. Drillhole B-16, River lode, at 620 ft. showed no appreciable oxidation. Most of the River lode ore should thus be amenable to ordinary sulphide flotation treatment. Since the oxidized ore of this lode occurs in rocks of considerable alkalinity, ammonia processes and the segregation process should be practicable for its treatment, rather than processes involving acid. The mixed ore of the Dambo lode is highly siliceous, making it adaptable, in the manager's opinion, to any of the ordinary oxidized-ore processes. The sulphide content is mostly chalcocite. Satisfactory laboratory-scale tests have been conducted at both London and N'Changa on extraction from ores of both lodes.

Flow of water at No. 9 vertical shaft, and on its 300 level, which started when driving and crosscutting the River lode was begun, reached the rate of 700,000 gal. per 24 hours by the end of 1928, and has increased gradually ever since. The syncline will have to be drained if best results of large-scale operations are to be obtained. This will necessitate an efficient pumping plant of considerable size to effect first drainage and to be in reserve against later emergencies. The problem is not expected to be difficult after first drainage is accomplished, if surface conduits are provided to keep rainfall over a 20-square-mile area from draining into the syncline.

At the beginning of the year, according to the annual report, N'Changa was employing 72 white and 725 colored workers. The quality of colored labor is said to be improving. Industrial inexperience of these workers has been less of a problem than the unfamiliarity of the European employee with African psychology. As living conditions, health, and treatment of workers at N'Changa are excellent, labor supply has been adequate without the necessity of recruiting.

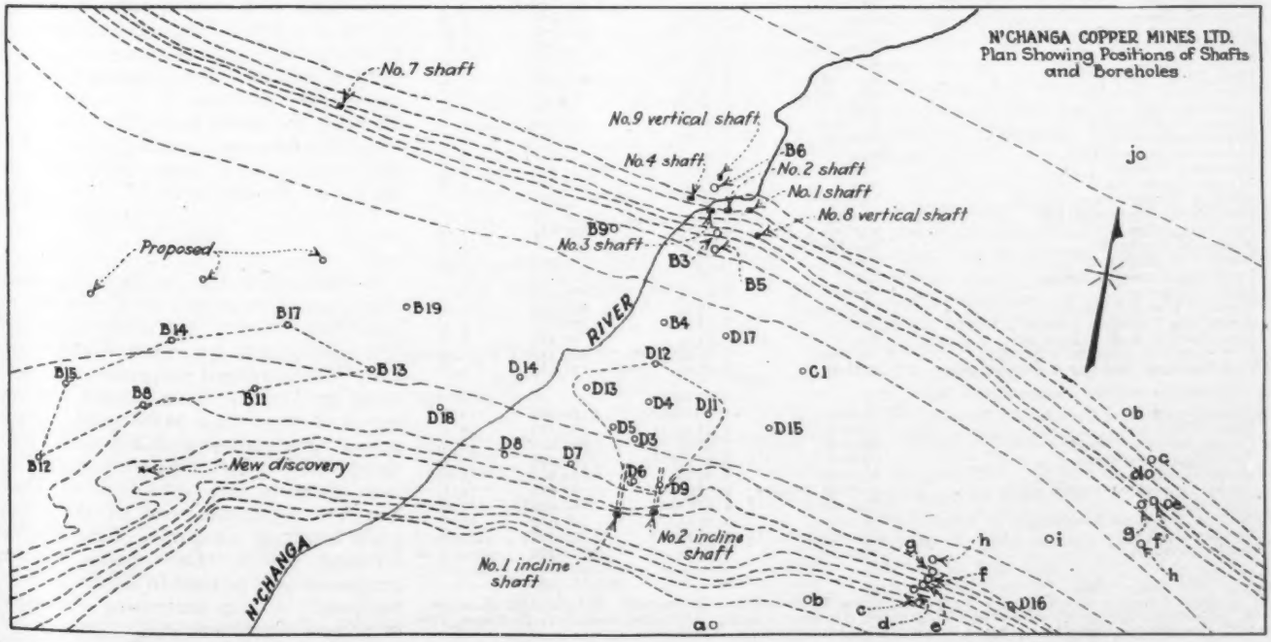
Diamond Drilling at N'Changa

Hole Number	From, Feet	To, Feet	Total Copper, Per Cent	Sulphide Copper, Per Cent
D3	395	430	4.30	0.60
D4	580	650	5.50	2.60
D5	390	480	2.70	0.90
D6	190	255	2.90	0.30
D7		No 2 per cent ore		
D8		No 2 per cent ore		
D9	110	180	3.70	0.40
D11	560	615	4.70	3.50
D12	795	820	2.20	1.80
D13	675	710	4.00	0.90
D14	630	720	2.30	1.10
D15	625	640	2.20	1.10
D16		No 2 per cent ore		
D17		No 2 per cent ore		
D18		15 ft. 2 per cent ore		
C1		Abandoned at 872 ft.		
B3	410	430	3.00	0.75
B4		Abandoned at 590 ft.		
B5		Abandoned above ore horison		
B6		Drilled in footwall for shaft sinking purposes		
B8	320	450	4.56	1.21
B9		Drilling		
B11	415	495	4.76	0.77
B12	265	310	4.64	1.20
	265	390	2.98	0.66
	265	435	3.04	0.49
B13	455	545	3.68	1.30
B14	735	830	2.93	0.58
B15	625	720	2.27	0.37
B16, from 300 level	305	395	4.35	4.28
B17	880	990	4.82	2.84
B19	815	915	5.1	....
B10, from 300 level	225	280	3.09	2.82

Plan of shafts and drillholes at N'Changa

Legend of Geological Strata, N'Changa Mine

a—Red granite
b—Quartzitic arkose
c—Sandy micaceous schist
d—Lower banded shale
e—Banded sandstone, quartzite, and schist
f—Feldspathic quartzite
g—Banded shale
h—Dolomitic schist
i—Cherty micaceous shale and sandstone
j—Boulder conglomerate



MARKET AND FINANCIAL NEWS

July Another Month to Show New Records in Mine Dividend Totals

AMERICAN metal-mining companies, made prosperous largely by increases in the prices they are obtaining for their products, notably copper, continue to increase dividend payments month by month. In July, total disbursements to stockholders by 38 companies amounted to $30,572,926—$4,000,000 more than was paid in April, the corresponding month in the last quarter, and $9,000,000 more than was paid last July. The following table shows vividly how payments in the first month of each quarter have grown during the last year:

	1927	1928	1929
Jan..	$18,960,995	$20,486,560	$25,603,109
Apr..	16,765,500	18,256,890	26,646,607
July..	18,901,426	21,230,143	30,572,926
Oct...	13,910,750	18,219,518	.....
Avg..	$17,134,668	$19,548,278	$27,607,544

Kennecott Copper, which alone pays more than one-third of the total, is responsible for at least half of the increase over the record of last July. Although payments made this month were nominally the same per share as last year—$1.25—the stockholders, like the Hydra of mythological fame, who, when one head was cut off, grew two in its place, have twice as many shares now as they had last summer. Six other companies engaged in the now highly profitable business of copper mining increased the total of their payments. Magma Copper, of Superior, Ariz., is paying $1.25 a quarter, instead of 75c. a share, paid last July; Phelps Dodge is paying 75c., equivalent to $3 on the old stock, which paid only $2 a share last year; Greene Cananea, which is bringing its Colorada mine into operation after three years of development work, has increased payments from $1 to $2 a share; Inspiration Consolidated, handicapped by comparatively high costs, paid no dividend last July, but will pay $1 a share this month; Howe Sound, operating lead-zinc properties in Mexico as well as its Britannia copper mine, has stepped its rate up from $1 quarterly to $1.50 a share; and Copper Range, in the Michigan copper country, is now on a basis of 50c. a share quarterly, instead of the $1 annual rate prevailing last year.

Metal & Mining Shares, one of several new holding companies, pays quarterly dividend of 30c. a share on the common stock and 75c. a share on the preferred stock this month. Two companies are included which have resumed payments since last July. These are American Zinc, Lead & Smelting, which returns to the ranks of the dividend payers after an absence of several years, with a payment of $1.50 a share on its preferred stock, and Eagle-Picher Lead, which resumed payments on its common stock in April and which is maintaining the rate then established of 20c. a share.

Two silver-lead-zinc operators in the Western districts, which have started payments only within the last year, have declared dividends for July and help thereby to swell the total for this month. These are North Lily, Anaconda subsidiary in the Tintic district, and Golconda Lead, independent producer in the Coeur d'Alene district. Santa Gertrudis, Mexican silver producer, will pay 7½ per cent on its capital this month, equivalent to 1s. 6d. per share. No corresponding dividend was recorded last July, although the company is on a regular basis of 15 per cent annually, equivalent to 2s. 6d.

Most of the absentees—that is, companies which paid last July and failed to do so this year—made their payments last month. Cleveland-Cliffs Iron, for instance, which paid $1 last July, declared an extra dividend of $5 a share last month. San Francisco Mines of Mexico, English company operating zinc mines in Chihuahua, Mexico, paid a dividend of 1s. 6d. in June instead of 1s. 3d. last July. Inland Steel, included last year, also paid in June. No dividend is reported for Cresson Consolidated, gold producer at Cripple Creek, although the latest news from the mine is fairly encouraging and the last quarter's profits were larger than for any quarter in the last year.

***E. & M. J.* Compilation of Mining Dividends and Yields for July, 1929**

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
Aluminum Company of America, pfd	Various	$1.50 Q	$2,214,930	5.8
American Smelting & Refining	Various	1.00 Q	1,829,940	3.7
Arizona Commercial, c	Ariz.	0.25 SA	66,250	14.3
American Zinc, Lead & Smelting, pfd	Tenn.	1.50 K	120,592	....
Bethlehem Steel, pfd	Various	1.75	1,697,500	5.8
Bingham Mines, s,l	Utah	0.87½ Q	43,750	4.3j
Bunker Hill & Sullivan, l,s,z	Idaho	0.75 MX	234,250	6.6
Consolidated Lead & Zinc	Kan., Okla.	0.25 Q	56,000	8.0
Copper Range, c	Mich.	0.50 Q	197,347	6.7j
Eagle-Picher Lead	Mo., Okla.	0.20 Q	200,000	2.2j
Eagle-Picher Lead, pfd	Mo., Okla.	1.50 Q	12,769	5.9
Golconda Lead, s,l,z	Idaho	0.20 Q	40,000	3.6
Homestake Mining, g	So. Dak.	0.50 M	125,580	9.6
Evans Wallower, pfd., l,z	Various	1.75 Q	21,875	6.2j
Inspiration Consolidated, c	Ariz.	1.00	1,181,967	6.5j
Kennecott Copper	Various	1.25 Q	11,246,044	6.8j
Magma Copper, c,s	Ariz.	1.25 Q	510,193	6.4j
Metal & Mining Shares, h	Various	0.30 Q	87,395	....
Metal & Mining Shares, pfd	Various	0.75 Q	3,114	....
New Jersey Zinc	Various	0.50 Q	981,632	3.6j
Newmont Mining, h	Various	1.00 Q	452,760	1.9
North Lily Mining, s,l	Utah	0.25 Q	198,888	13.6j
Park Utah Consolidated, l,z	Utah	0.20 Q	418,700	11.0
Phelps Dodge, c	Various	0.75 Q	1,500,000	4.1j
Republic Iron & Steel, pfd	Various	1.75 Q	437,500	4.3j
Silver King Coalition, s,l,z	Utah	0.25 Q	305,117	8.4j
Sloss-Sheffield Steel & Iron, pfd	Ala.	1.75 Q	40,247	9.9j
U. S. Smelting, Refining & Mining	Various	0.87½Q	306,350	6.4
U. S. Smelting, Refining & Mining, pfd	Various	0.87½Q	425,557	6.5
Companies in Other Countries				
Consolidated M. & S., s,l,z	Canada	6.25 SAB	3,180,394	3.2
Dome Mines, g	Canada	0.25 Q	238,333	10.4
Greene Cananea Copper, c	Mexico	2.00 Q	1,000,000	4.1j
Höllinger Consolidated, g	Canada	0.05 FW	246,000	13.5j
Howe Sound, c,l,z	Mexico	1.50 Q	744,057	6.7j
Lucky Tiger-Combination, g,s	Canada, Mexico	0.02½ M	17,895	16.1j
Nipissing, s	Canada	0.075 Q	90,000	11.4
N. Y. & Honduras Rosario, g,s	Honduras	0.50 QX	100,000	13.9j
Premier Gold, s,g	Canada	0.06 Q	300,000	13.0j
Santa Gertrudis	Mexico	0. 1s.6d.	£135,000	....
Total			$30,572,926	

s, silver; l, lead; z, zinc; g, gold; c, copper; h, holding; R, resumption; Q, quarterly; M, monthly; X, extra K, irregularly; QX, $0.25 regular and $0.25 extra; SA, semi-annually; SAB, semi-annual, $1.25, bonus, $5; MX, monthly 25c., extra 50c.; j, based on dividends for the last twelve months.

RAWANG TIN FIELDS, LTD., has been organized with capital of £1,000,000 to take over Rawang Tin, Ltd., Serendah Tin, Ltd., and Serendah South Tin, Ltd. The combined properties, all operating in Malaya, have proved ore reserves of more than 34,000 tons. With annual production at 2,290 tons, they should have a life of fifteen years. The new company is a subsidiary of London Tin Syndicate, one of the three great financing companies of the Anglo-Oriental group. Cash assets of the companies will be used in acquiring new equipment and in increasing efficiency of present equipment.

Zinc Tariff Merry-Go-Round Makes Everybody Happy

THE following comment on the efforts to increase the tariff on zinc ore is taken from *Daily Metal Trade,* of Cleveland:

"The famous Schwab story of the colored boy who spent all his money on the merry-go-round, riding 'round and 'round, and finally alighting at the same spot where he climbed aboard, is illustrative of many phases of the present tariff controversies. The vicious circle occurs again and again.

"The zinc industry got worked up over threatened importations from Canada of low-content zinc ores which now can be worked profitably and sold in competition with domestic zinc. Prior to the innovation of new milling and smelting methods these ores were not practical contenders in domestic markets and no objections were voiced by the zinc industry because the bulk of these Canadian ores was on the free list. Now that the possibility of competition from this source has arisen, the industry is actively soliciting protection in the form of tariff.

"Under the Fordney schedule, Canadian ore containing less than 10 per cent zinc was admitted free, with graduated duties beginning at one-half cent for 10 per cent ore up to one and one-half cents for ores containing 25 per cent or more zinc. The zinc industry asked for the maximum tariff on all zinc-bearing ores. Then the circle began to get into action. These ores are imported primarily for the sulphur content, used for making sulphuric acid, a necessary ingredient in the production of superphosphate; and superphosphate is one of the mainstays of the American farmer when it comes to fertilizers. Therefore, the fertilizer interests objected strenuously when the zinc people began to talk about a tariff schedule with teeth in it.

"So the circle was set up. Higher duty, protect the zinc producers, raise the price of fertilizer, lessen the money the farmer has for zinc-coated roofs and other zinc products, thus curtail the output of zinc, increase production costs and put the imported ores in a position to compete despite a higher tariff. On this particular merry-go-round ride someone reached out and grabbed the brass ring in the form of a compromise which seems to satisfy everybody and therefore should be approved by the tariff committee. The proposed new schedule agreed upon by all parties will permit the pyrite ore, valuable to the makers of fertilizer, containing less than 3 per cent zinc to come in free of duty, thus precluding the penalizing of the American farmer. On the other hand, the native zinc industry will benefit by additional protection. So on this particular merry-go-round ride a good time was had by all, which is as it should be."

British Tin Producers' Association Organizes

ALTHOUGH the British Tin Producers' Association, recently formed to stabilize that industry, has no definite plans for the future, a provisional council has been organized, which will direct a program of research in marketing problems. Participating in the association are 167 companies, controlling nearly half the world's output of tin. Members of the council, as announced by Sir Edmund Davis, chairman, are as follows:

Representing Malayan production: Sir Ernest Birch, M. I. Attenborough, E. F. Byrne, A. W. Freeman, John Howeson, F. E. Main, R. T. Mieg, J. M. Newman, A. K. Palfreyman, R. Pawle, M. N. Seller, C. V. Stevens, C. V. Thomas, and H Waugh. Representing Nigerian production: G. Temple Harris and Lionel Holland; Burmese and Siamese interests, Sir Cyril Butler and W. H. Edwards; Cornish production, Sir A. M. Rogers and St. John Wynne; and Australia, O. T. Leepriere.

Large Increase in Nickel Output of Canada

Canadian nickel production during 1928, according to finally revised statistics reported by the Dominion Bureau of Statistics, was 96,755,578 lb., valued at $22,318,907, as compared with 66,798,717 lb., worth $15,262,171, in 1927. These figures include nickel in matte exported by the Mond Nickel and International Nickel; refined and electrolytic nickel produced by International Nickel; nickel in nickel oxide and nickel salts sold from Deloro and Port Colborne, and nickel contained in speiss residues exported.

Production in Canada and Exports of Nickel, 1927 and 1928

	1927		1928	
	Quantity, Pounds	Value	Quantity, Pounds	Value
Production				
Nickel in matte and speiss exported (a)	31,584,097	$5,685,138	37,783,991	$6,801,118
Refined and electrolytic nickel produced	28,469,996	7,497,436	49,144,875	12,596,371
Nickel in oxides and salts sold	6,744,624	2,079,597	9,826,712	2,921,418
Total	66,798,717	$15,262,171	96,755,578	$22,318,907
Exports				
Nickel, fine	29,015,800	$7,896,211	51,188,700	$13,320,034
Nickel contained in matte	36,458,800	5,784,623	36,370,800	5,457,222
Nickel oxide (b)	5,196,100	1,600,986	9,607,200	3,004,951
Total	.....	$15,281,820	.....	$21,782,207

(a) Nickel in matte and speiss exported valued at 18c. per pound.
(b) Nine months 1927.

World Zinc Production Decreased in June

DATA compiled by the American Bureau of Metal Statistics show that the daily rate of world zinc production declined slightly in June, following a similar tendency in May. None of the countries producing zinc, however, reflected much change from average rate of the first six months of the year.

A tabulation of the June, 1929, production, and the January-June average follows:

Slab Zinc Production, in Tons

	June	Average, Jan.-June
United States	52,953	52,983
Belgium	18,239	18,234
Poland	16,196	16,061
Germany	9,893	9,564
France	8,488	8,585
Canada	7,240	7,544
Great Britain	5,966	5,488
Australia	4,670	4,713
Netherlands	2,368	2,387
Mexico	1,373	1,292
Spain	1,047	1,056
Rhodesia	1,042	1,008
Elsewhere	5,000	4,750

The total monthly production in June was 134,475 tons, making the daily rate 4,483 tons, compared with 140,379 and 4,528 tons respectively in May, and 131,382 and 4,308 tons respectively for the year 1928.

Negotiations Off for Purchase of Commerce by Anaconda

NEGOTIATIONS between Commerce Mining & Royalty and Anaconda Copper, for purchase of the former's zinc and lead holdings in the Tri-State district, valued at close to $25,000,000, which have been going on intermittently for the last few years, are said to have been definitely called off.

Commerce has leased or owns in fee more than 15,000 acres of mining land in the Tri-State district. It is estimated that the company has developed more than 3,000,000 tons of commercial zinc concentrates. The company also owns its own electric power house, which furnishes electric power not only to its fifteen active mills but also to the Northeast Oklahoma Railroad, a subsidiary.

BURMA CORPORATION, LTD., operating in the Federated Shan States of Upper Burma, mined 38,960 tons of ore in June, of which 3,320 tons was classed as high-grade ore. Products were 6,545 tons of refined lead; 590,620 oz. of refined silver; 4,640 tons of zinc concentrates, assaying 8.1 oz. per ton silver, 4 per cent lead, and 53 per cent zinc; 1,245 tons of copper matte; and 100 tons of refined antimonial lead.

CALLAHAN ZINC-LEAD COMPANY, operating in the Coeur d'Alene district, reports loss of $25,572 for the first three months of 1929, before allowing for depreciation and depletion. Net value of shipments was $11,041, and operating and development costs amounted to $42,473.

World Lead Production at New Peak in June

THE rate of world lead production continues to show a slight increase from month to month, June figures being the highest yet, 5,467 tons per day, compared with 5,440 in May, 5,418 in April, and an average of 4,976 for last year, according to the American Bureau of Metal Statistics.

Pig lead production, in tons, is distributed among the various countries as follows:

	June 1929	Average Jan.-June, 1929
United States	57,742	58,083
Mexico	25,586	22,974
Australia	16,044	15,447
Canada	12,806	12,259
Spain and Tunis	11,052	10,353
Germany	8,917	9,223
Burma	7,442	7,443
Poland	3,177	2,972
Italy	2,205	1,802
Peru	1,875	1,602
Rhodesia	174	290
Elsewhere, estimated	17,000	16,500

United States production, which excludes lead obtained from foreign ores smelted in that country, is 35 per cent of the world's total.

U. S. Silver Production Continues at High Rate

THOUGH silver prices are several cents lower than last year, when they averaged 58c. an ounce, production in the United States has been larger so far in 1929, averaging 5,088,000 oz. per month, compared with 4,679,000 oz. last year. Without doubt, recovery of silver as a byproduct of copper and lead has been the principal factor in this increase, both of these base metals selling at a higher price this year than last, particularly copper, of course. Canadian and Mexican production, on the other hand, has declined. Data compiled by the American Bureau of Metal Statistics follow:

Silver Production of Important Countries

In thousands of fine ounces

	Monthly Average Year, 1928	Jan.-June, 1929	June, 1929
Mexico	9,045	(a) 7,762	(c)
United States	4,679	5,088	5,003
Peru	1,712	1,797	1,973
Canada	1,694	1,383	1,146
Australia	678	686	730
Burma	617	(b) 617	(c)
Bolivia	464	(a) 468	(c)
Total (d)	18,889	17,801	(c)

(a) First three months only; (b) first five months only; (c) not yet available; (d) these countries produced 88 per cent of the world's silver in 1928.

Combined foreign and domestic stocks of silver are the highest for years, totaling 1,382,000 oz. at the end of June, compared with 1,011,000 oz. at the end of 1928, 353,000 oz. at the end of 1927, and 326,000 oz. at the end of 1926. Silver stocks in India are about normal, being 349,147,000 oz. on June 22, but are somewhat above normal in Shanghai, being 188,891,000 oz. on June 29, compared with 147,195,000 oz. at the beginning of the year.

The Statist, of London, points out that the present price of silver expressed in terms of the average price of all other commodities is almost exactly the same as it was in 1915. The Continent, where demonetized silver continues to be thrown on the market, has been a source of recent weakness.

SYLVANITE GOLD MINES, LTD., operating in the Kirkland Lake district of Ontario, earned net profits of $95,474, not allowing for depreciation or depletion, in the year ended March 31, 1929. In the previous year, during which the mill was in operation only eight months, profits were $158,081. In the year covered by the present report, 70,833 tons of ore was milled, yielding $10.62 per ton, or $737,573, of bullion. Operating costs were $573,483, or $8.096 per ton, divided as follows: development and exploration, $170,695; mining, $234,177; milling, $94,025; and general and administrative charges, $74,584. The large increase in development work was responsible for the lower profits.

HOWE SOUND COMPANY, operating in British Columbia and Mexico, reports net income, less depreciation, of $1,028,682 for the second quarter of 1929. In the first quarter income was $990,284. The following table shows production of the various metals:

	Second Quarter 1929	First Quarter 1929
Gold, oz	3,683	3,454
Silver, oz	723,673	700,446
Copper, lb	10,904,510	10,214,981
Lead, lb	19,610,556	20,456,992
Zinc, lb	15,322,915	17,317,282

MCINTYRE PORCUPINE MINES, LTD., operating in the Porcupine district of Ontario, netted profit of $441,179, before depreciation, during the second quarter of 1929. This was $6,695 more than was earned in the corresponding period of 1928. Gross income was $1,062,611, and operating costs, including development, were $592,499.

TEXAS GULF SULPHUR reports net earnings of $3,571,270 for the quarter ended June 30. After paying a dividend of $2,540,000 on June 15, earnings were applied to surplus and reserve for depletion, making a total of $17,672,613 on June 30, 1929. During the three months' period reserves for depreciation were increased by $319,889, making a total of $11,821,896. All assets subject to depreciation at Gulf, Tex., are now offset by these reserves.

FRENCH POTASH PRODUCTION in 1928 was 427,997 metric tons. Of this, 201,967 tons, or nearly 50 per cent, was marketed in France, following the trend of recent years toward increased domestic consumption. Statistics of the industry for the last five years, as furnished by the U. S. Department of Commerce, follow:

Calendar Year	Total Production Metric Tons, K_2O	Sales: Total Metric Tons, K_2O	Sales: Domestic Metric Tons, K_2O	Sales: Foreign: United States Metric Tons, K_2O	Sales: Foreign: Other Countries Metric Tons, K_2O
1924	269,783	274,477	98,546	76,827	99,104
1925	303,385	329,720	124,007	98,468	107,245
1926	352,034	350,987	154,916	85,431	110,640
1927	333,273	317,520	145,953	66,663	104,904
1928	427,997	403,397	201,967	83,590	117,840

No Changes Expected in Coin Currency

INTRODUCTION of the new paper currency in the United States does not presage any changes in coinage for some time to come. The Treasury Department has a free hand with respect to currency issues, but its policy with reference to minting is largely determined by statute. The weight of the coins is prescribed by law, and changes may be made in their design only once in 25 years. This restriction is to prevent confusion resulting from the circulation of coins of several designs in one denomination.

The most recent change in the design of any of the coins was in 1921, when a silver dollar of new design was minted. United States half dollars, quarters, and dimes were last changed, as to design, in 1916. The "buffalo" nickel made its appearance in 1913 and the Lincoln penny in 1909. The $2.50 and $5 gold pieces were issued in new designs in 1908, and the designs of the $10 and $20 gold pieces were changed in 1907. Hence the statute will permit a change in the design of the penny in 1934, but the dates for a change in the designs of the other subsidiary coins are rather far removed.

There has been general uniformity in the issuance of coins, only three of them—the 2c. bronze piece, the 3c. silver piece and 5c. silver piece—having been discontinued. The 2c. piece was minted in 1863 and discontinued in 1873 because of confusion with the 1c. piece. The 3c. piece was minted in 1851 and discontinued in 1873 because of its similarity to the dime. In 1792 the 5c. silver piece, or half dime, was first minted, and it was not discontinued until 1873. Confusion with the dime also was the reason for its replacement with the nickel.

DOME MINES, LTD., operating in the Porcupine district of Ontario, reports approximate income for the first six months of 1929, not allowing for depreciation or depletion, as $1,208,895. A total of 275,000 tons of gold-bearing ore was milled. Recovery was $7.908 per ton, and operating costs were $3.803 per ton.

UNITED STATES SMELTING, REFINING & MINING reports as of April 30, 1929, total assets of $86,986,804, comparing with $76,284,915 on Dec. 31, 1928, and profit-and-loss surplus of $18,211,934, against $17,629,242. Current assets on April 30 amounted to $22,606,069 and current liabilities $10,435,615, comparing with $12,026,469 and $3,759,638 respectively at the close of 1928.

London Financial News

By W. A. Doman
Special London Correspondent

London, July 10, 1929—Relatively little of interest has occurred to report in the mining world. Most of the important meetings have been held, and the holiday season is fast approaching. This means that fireworks, so far as concerns news likely to affect the market price of shares, are not to be expected again for some time. Ashanti Goldfields announces excellent developments on its 21 and 22 levels, and the outlook for the company seems good. Shamva, in Rhodesia, is proving disappointing.

At the moment one hears little of the great tin stabilization scheme apart from the calling of a conference for tomorrow. Referring to the Tin Producers' Association at the annual meeting of the Lahat Mines, Walter J. Payne, the chairman, said the directors would be opposed to having their hands tied to any combination created for the purpose of restricting output. The company's returns had fallen off, and the aim of the board was to increase rather than to diminish production. Tavoy Tin Dredging Corporation earned a gross profit last year of £51,086, or nearly £45,000 less than in 1927. Some critics are disappointed at the performance, though the price of the metal was lower; boulders appear to be a nuisance, and there is almost a suggestion that the life of the area will not exceed a decade. Actual working costs per cubic yard were 6.84d. Gerald H. Hutton, on behalf of Anglo-Oriental (Malaya), recommends mechanical improvements to dredges, exploiting of ground suitable for gravel pumping, and more effective supervision and control.

A good deal of activity is noticeable in the Cornish mines. The sands of the seashore at Gwithian have been regularly washed since February, though with what financial results is not yet known. A syndicate with extensive capital will dredge the River Tamar above Saltash Bridge for tin, according to reports.

Lead producers have held their regular half-yearly meeting in London. Statistics disclosed a satisfactory position, and it was found that there was no necessity to take any action to reduce output. It was agreed to continue for the remainder of the year the arrangement made in September last imposing a restriction in output in the event of any adverse change in the situation.

British Swiss International Corporation has entered into agreements with the government of the Union of South Africa and Union Manganese Mines & Minerals (S.A.), Ltd., which "place your corporation at one stroke in the forefront of one of the great key industries of the world—namely, the manganese industry." The chairman stated that the manganese deposit at Postmasburg is one of the mining wonders of the world; it runs practically continuously for over 40 miles north and south and contains an estimated quantity of ore in excess of 1,000,000,000 tons. It is the largest reserve of manganese ore in existence. The ore does not require blending or washing, and "profits will be shown if manganese falls to 9d. per unit c.i.f. or even lower." Manganese Corporation (1929) will be able to dispose of 400,000 tons of ore per annum, at a profit of upward of £1 per ton.

N'Changa Copper Mines, Ltd., owning a copper property in Northern Rhodesia, presents the following statement of accounts for the year ended Dec. 31, 1928:

	£	£
Capital authorized and issued 600,000 shares of £1 each	.....	600,000
Creditors		
Rhodesian Congo Border Concession	39,754	
Other accounts	11,911	
		51,666
		£651,666
Purchase consideration of mining rights	290,000	
Less—Plant transferred to equipment account	32,806	
		257,193
Expenditures upon equipment and development as of 1927 balance sheet	176,063	
Add—Further expenditure	101,407	
		277,471
London office expenditure, as of 1927 balance sheet	4,233	
Add—Further expenditure	6,245	
		10,478
Total	.....	£545,143
Underwriting commission	15,000	
Amount paid for 75,000 shares issued at par in 1928	5,625	
		20,625
Preliminary expenses	.....	9,581
Buildings and mechanical transport	.....	13,145
Stores	.....	19,496
Debtors	.....	1,853
Cash on deposit with Lazard Bros. & Company, Ltd	34,198	
Cash at bank and in hand	7,622	
		41,820
		£651,666

Transvaal Gold Output for May was 897,598 fine oz., valued at £3,812,754, an increase of 25,475 oz. over April production. The figures for the Rand constitute a record, exceeding the previous high of October, 1928, by 46 oz.; but production from mines outside the Rand declined. Details of production from nineteen leading Rand mines follow:

Mine	Tons Crushed	Value, or Revenue £	Costs per Ton s.	d.
Gov't. Areas	210,000	399,021	16	2.9
New Modder	152,000	316,509	17	6.2
Crown Mines	223,000	309,583	20	10.7
Modder Deep	45,900	103,041	15	6.0
Springs	72,000	145,468	21	9.4
New State Areas	81,000	142,216	20	5.2
Brakpan	92,500	152,201	19	10.2
Modder B	71,500	108,880	17	3.0
Geduld	85,000	114,586	16	6.0
Van Ryn Deep	67,000	108,699	19	7.9
Sub Nigel	24,300	.....	48	2.9
Langlaagte	85,000	114,422	20	10.4
West Springs	65,100	80,838	18	1.4
Modder East	70,000	90,302	20	4.2
Randfontein	216,000	213,707	18	4.7
West Rand Cons.	90,000	95,031	17	6.7
Robinson Deep	79,000	.....	19	9.0
Cons. Main Reef	59,000	93,334	26	5.9
East Rand Pr	145,500	166,231	21	3.2

Nipissing Mining Company, Ltd., operating at Cobalt, Ont., mined ore of an estimated net value of $180,291 during the three months ended June 30. Bullion and residues of a value of $203,747 were shipped.

Cons. M. & S. Metal Output Shows Decrease for Quarter

Consolidated Mining & Smelting reports metal production for the quarter ended June 30 of 38,594 tons of lead, 22,783 tons of zinc, 32 tons of copper, 3,040 oz. of gold, and 1,495,424 oz. of silver. This compares with a metal production of 40,136 tons of lead, 19,685 tons of zinc, 2,438 tons of copper, 6,037 oz. of gold, and 1,734,185 oz. of silver for the corresponding quarter of 1928.

The decrease in lead is a result of the treatment of lower-grade ore in which the ratio of lead to zinc is less than in the ore treated a year ago. The decrease in copper was caused by the diversion of Granby's Allenby concentrate to the Tacoma smelter. This also accounts for the lower silver and gold production to some degree, as Rossland gold-copper ore was used to flux the Allenby concentrate. Except as a flux this material cannot be profitably smelted.

Union Minière Reports 1928 Profit of 254,033,648 Francs

Union Minière du Haut-Katanga, producing copper, tin, cobalt, and radium in the Belgian Congo, presents the following balance sheet, as of Dec. 31, 1928:

	Francs	Francs
Fixed assets, less amortization	563,760,805	
Materials and provisions	266,322,269	
Titles	67,407,365	
Products:		
Minerals in stock	21,545,844	
Metals	410,163,869	
Accounts receivable	233,112,562	
Cash	45,525,165	
Total assets	.....	1,607,857,832
Capital	525,400,000	
Surplus	131,798,656	
Long-term indebtedness	403,600,000	
Short-term indebtedness	276,244,672	
Accounts payable	6,373,885	
Undisbursed dividends	10,406,969	
Profit and loss	254,033,648	
Total liabilities	.....	1,607,857,832

Operating profit for the year amounted to 395,904,393 francs.

Libiola Copper Mining, owning the Libiola copper mines, in northern Italy, reports that during the financial year ended Dec. 31, 1928, 11,854 tons of pyrites and 2,042 tons of copper ore were produced, compared with 10,979 tons and 3,555 tons respectively in 1927. This resulted in a net profit of £69, against a net loss of £1,488 in the previous year. The directors report that the transfer by way of sale of the company's mines and properties to an Italian company, the Societa per l'Esercizio della Miniera di Libiola, has been completed.

Engels Copper Mining reports net profits for the first six months of 1929 as approximately $306,800. Costs were cut at its Plumas County mines to 13.2c. per pound. During the last half of the year costs are expected to average around 12.6c. per pound.

The Market Report

Fair Demand for Metals Continues; Little Change in Price

New York, July 24, 1929.—The last week in the metal markets has been featureless. Demand for copper, lead, and zinc has been about the same as it was a week before—that is, better than it was during most of the spring, but still not what one could call at all active. The strength in tin has continued, prices moving up above 47c. Other metals show little or no change quotationally. Most of the metal consumers continue to buy only for immediate requirements.

Daily Prices of Metals

July	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
18	17.775	46.50	6.75	6.55	6.80
19	17.775	47.50	6.75	6.55	6.80
20	17.775	No Market	6.75	6.55	6.80
22	17.775	47.375	6.75	6.55	6.80
23	17.775	47.375	6.75	6.55	6.80
24	17.775	47.375	6.75	6.55@6.60	6.80
	17.775	47.225	6.75	6.556	6.80

Average prices for calendar week ending July 20, 1929, are: Copper, 17.775; Straits tin, 46.975; New York lead, 6.75; St. Louis lead, 6.55; zinc, 6.775; and silver, 52.979.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

July	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic bid	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
18	71	71 13/16	84	210 3/4	214	22 1/2	22 5/8	25 3/8	25 7/16
19	72 3/4	73 3/8	84	214	217 1/4	22 11/16	22 13/16	25 3/8	25 3/8
22	72 3/4	73 3/8	84	214 3/4	218 1/4	22 13/16	22 7/8	25 5/16	25 3/8
23	72 1/8	72 7/8	84	212 1/2	216 1/4	22 5/8	22 11/16	25 1/4	25 5/16
24	72	72 5/8	84	214 3/4	218 3/4	22 7/16	22 5/8	25 1/16	25 1/4

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver		Gold London	July	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
18	4.84 5/8	53 1/4	24 1/2	84s11 1/2d	22	4.84 5/8	52 5/8	24 3/8	84s11 1/2d
19	4.84 1/2	53 1/2	24 13/32	84s11 1/2d	23	4.84 13/16	53	24 1/2	84s11 3/8d
20	4.84 1/2	53 1/2	24 11/16	.....	24	4.84 3/4	52 5/8	24 7/16	84s11 1/2d

Average: Silver, 53.021c.; Sterling Exchange, 484.635c.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Copper Not Yet Active

A fair demand for copper has been met largely by the custom smelters at unchanged prices of 18c. for Eastern deliveries and 18⅛c. in the Middle West. The large producers continue out of the market except for special shapes or where other special conditions apply, in spite of the fact that they have so far sold virtually none of their expected August production. Over half of the demand has been for immediate shipment, and about 40 per cent for August, leaving only a few hundred tons sold for September and October, months for which one would normally expect buying at this time of the year. Consumers, however, are postponing buying as long as possible, in some instances asking for their August copper to be shipped this month. Thus is demand piling up, which soon must be reflected in more active business. Consumers are not curtailing their operations, but they have noticed a marked decrease in orders on their books; instead of being booked for five or six months ahead, as some of them were last winter and early spring, they now have orders for only six weeks or two months ahead. But many have not provided themselves with copper sufficient even to take care of the orders on their books. Wire manufacturers are perhaps in the best position so far as orders are concerned. Brass and sheet copper manufacturers report continued dullness.

Foreign demand has been rather better, especially the last two days, at unchanged prices of 18.30c., c.i.f. It is generally accepted that foreign buying is likely to pick up before domestic.

Zinc Firmly Held at 6.80c.

Zinc buying has been considerably better since the quotations became uniform at 6.80c., St. Louis, than it was when one or two sellers were offering concessions. Sales during the last week again were fairly good, though probably not equal to production. Also, they were unequally distributed, some sellers complaining that the 6.80c. quotation was entirely unattractive to possible buyers. Those that sold, however, had a fair response from the galvanizing trade, with specified shipments varying from prompt to December, but with September in chief demand. Spot carloads of high-grade zinc continue to be quoted at 8c., delivered in the East, though this price may be revised upward in view of the firm 6.80c. St. Louis quotation for Prime Western.

Improved Lead Demand Curtailed by London Reaction

Volume of sales in the domestic lead market for the past week is but little changed from the total reported for the week immediately preceding. A good proportion of the business reported for the *E.&M.J.* week ending today was

consummated last Thursday and Friday, when lead quotations on the London metal exchange were advancing. Since then, however, London quotations have weakened and the demand from domestic consumers has slackened. A large proportion of the business continues to be done in the form of carload lots for early delivery, forcing the impression that the lead market is rapidly returning to a condition of strictly hand-to-mouth buying.

In the St. Louis market last Thursday and Friday sales of second-hand lead were reported as low as 6.50c. per pound. Information concerning direct sales from producers to consumers on this basis is not available, however. A forward sale in St. Louis for a good tonnage brought 6.60c. today.

The reaction of buyers to the weakness in London lead prices is only natural, and, as has been the situation for some time, all hope for early improvement in the condition of the lead market appears to rest with the possibilities for higher prices abroad.

Tin Prices Higher

New developments of a fundamental nature are lacking in the tin market for the last week, though today's prices are approximately ½c. per pound higher than a week ago. Consumer buying in good volume is reported, in large part for forward delivery. Speculative interests have been in and out of the market, resulting in day-to-day price fluctuations of considerable moment in one or two instances during the week. As all the tin-trading agencies in New York are closed on Saturdays during July and August, and any quotation for that date is nominal, *Engineering and Mining Journal* will not publish a Saturday quotation for tin until conditions change.

Silver Has Its Ups and Downs

The sharp advance in silver prices last week was brought about by bear covering and speculative buying in anticipation of serious trouble between China and Russia. As soon as it appeared that hostilities were not imminent, the price dropped sharply. The market appears barely steady at the close.

Mexican Dollars (old Mexican pesos): July 18th, 40⅜c.; 19th, 40⅝c.; 20th, 40¼c.; 22d, 40c.; 23d, 40¼c.; 24th, 40c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 8½@8⅝c. per lb. for all positions. Cookson's "C" grade, spot, 14c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM — Per lb., New York: 80@95c. Active demand.

IRIDIUM — Per oz., $230@$240 for 98@99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, $68 per oz. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $121@$122. Small lots command the usual premiums. Market is largely nominal at the moment, as most dealers are holding out and quoting above the market until definite information is available concerning the new European price basis. Active consuming interest.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of July 6.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $15.75@$16.25 for future delivery; Western scheelite, $15.50 for October and November delivery. Bolivian scheelite available at $16 for August to December position. Keen demand reported from Europe for nearby positions.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the July 6 issue.

Joplin Markets Unchanged

Joplin, Mo., July 20, 1929

Blende	Per Ton
High	$46.50
Premium blende, basis 60%..	$44.00@ 45.00
Prime Western, basis 60%..	43.00@ 44.00
Table concentrate, 60%.....	41.00@ 43.00
Flotation concentrate, 60%..	39.00@ 41.00
Average settling price, all ore	43.60

Galena	
High	$87.90
Basis 80 per cent lead.....	85.00
Average settling price, all ore	87.19

Shipments for the week: Blende, 11,488; lead, 1,148 tons. Value, all ores the week, $600,950.

No change occurred in zinc concentrate prices, but sellers were slow to accept offerings. Shipment, production, and sales approximately balanced. Production was limited by labor shortage, as many miners who went to the harvest fields just after July 4 have not yet returned. Extra cars are held in the mining section, with a shortage of cars for grain shipments—a very unusual occurrence.

Platteville, Wis., July 20, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc.....	$46.75

Lead Ore	
Lead, basis 80 per cent.....	$90.00

Shipments for the week: Blende, 623 tons; lead, 40 tons. Shipments for the year: Blende, 19,599; lead, 1,140 tons. Shipments for the week to separating plants, 1,239 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the July 6 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Market active.

SODIUM NITRATE — Per 100 lb., $2.07½ for late July deliveries, new basis.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the July 6 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $34 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.40@$1.45 f.o.b. works. Market firm.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the July 6 issue.

Rolled Metals

LEAD SHEETS—10½c. per lb. for full rolled and 11c. per lb. for clipped sheets.

Copper, Zinc, Monel Metal, and Nickel Sheets are unchanged from prices in the July 6 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of July 6.

Iron, Steel and Coke

IRON—Per gross ton, Valley furnaces, Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL—Base prices per gross ton Pittsburgh, billets and slabs, $35; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE—Per gross ton, Connellsville furnace, $2.75@$2.85. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis) $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended July 20, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda Copper	New York	115⅞	109¾	115⅞	Jl. 13, Au. 19	Q 1.75
Andes Copper	New York	51¼	48½	51¼	Jl. 13, Au. 12	Q 0.75
Arizona Com	Boston	3½	2¾	2¾	Jl. 16, Jl. 31	SA 0.25
Calumet & Ariz	New York	128½	123	127½	My.31, Je.17	Q 2.50
Calumet & Hecla	Boston	41¾	39½	40½	My.31, Je.29	Q 1.00
Cerro de Pasco	New York	96	94½	94½	Jl.11, Au. 1	Q 1.50
Con. Coppermines	N. Y. Curb	11	10¼	10¼		
Copper Range	Boston	21⅜	21	21⅛	Je. 15, Jl. 15	Q 0.50
East Butte	Boston	2¼	2¼	2¼	Dec., 1919	0.50
Granby Con	New York	79	76	76½	Jl.12, Au.1	Q 1.75
Greene Cananea	New York	172½	166½	170	Je. 6, Jl. 1	Q 2.00
Howe Sound	New York	69½	64½	68½	Je. 29, Jl. 15	Q 1.50
Hudson Bay	N. Y. Curb	17½	16½	16⅝		
Inspiration	New York	44¼	41½	43½	Je.13, Jl. 1	Q 1.00
Isle Royale	Boston	22	21	22	My. 31, Je.29	0.50
Kennecott	New York	87½	83½	87½	My. 31, Jl. 1	Q 1.25
Magma Copper	New York	67⅜	63	67	Je.28, Jl.15	Q 1.25
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅜		
Miami Copper	New York	43½	40	43½	Au. 1, Au. 15	Q 1.00
Mohawk	Boston	56½	54½	56	Jl. 31, Se. 2	Q 2.00
Mother Lode	New York	3½	3	3	Je. 13, Je. 29	0.20
Nevada Con	New York	45½	42½	45½	Je. 14, Je. 29	Q 0.75
Noranda	N. Y. Curb	60	57½	59		
Ohio Copper	N. Y. Curb	2	1½	1⅞	Sept., 1926	0.03
Old Dominion	Boston	10	9½	9½	Dec., 1918	1.00
Phelps Dodge	New York	62½	59	61	Je. 4, Jl. 1	Q 0.75
Quincy	Boston	37	32½	37	March, 1920	1.00
Roan Antelope	N. Y. Curb	45	41⅝	41⅝		
St. Mary's M. L.	Boston	35½	34	35	Fe.25, Mr.12	2.00
Seneca Copper	New York	5	5	5		
Shattuck Denn	N. Y. Curb	17	16	16½		
Sherritt-Gordon	Toronto	7.90	7.50	7.70		
Tenn. C. & C.	New York	18⅛	17⅛	18⅛	Au.31, Se.16	Q 0.25
United Verde Ex.	N. Y. Curb	16½	16	16	Jl. 2, Au. 1	Q 1.00
Utah Copper	New York	....	....	318	Je. 14, Je. 29	Q 4.00
Waite-Ack.-Mont.	Toronto	6.25	5.00	6.00		
Walker Mining	Salt Lake	....	....	4.05		
Wenden Copper	N. Y. Curb	1⅛	1	1		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	1⅞	1⅝	1⅝		
Amer. Z. L. & S.	New York	26	22½	23	May, 1917	1.00
A. Z. L. & S., pfd.	New York	92	91	91	Je.14, Jl. 1	1.50
Bunker Hill & S.	N. Y. Curb	136	131	131	Ap.25, My.6	X 0.75
Butte Cop. & Zn.	New York	4⅛	4⅛	4⅛		
Butte Cop. Con.	Boston Curb	*50	*35	*37		
Butte & Sup.	New York	8⅜	8	8	Je. 14, Je. 29	Q 0.50
Callahan Zn-Ld.	New York	1⅛	1⅛	1⅛	Dec., 1920	0.50
Chief Consol.	Salt Lake	3.35	3.25	3.30	Fe. 1, 1928	K 0.10
Consol. Ld. & Zn. "A"	St. Louis	12	11⅛	12	Je.20, Jl.1	Q 0.25
Constitution	Spokane	....	....	*39½		
Dayrock	Spokane	....	....	3.50	Je.20, Je.30	0.03
Dickens Consol	Spokane	....	....	*4¼		
Eagle-Picher	Cincinnati	17	16¾	17	Je. 30, Jl.15	Q 0.20
Eagle-Pich., pfd.	Cincinnati	....	....	102	Je. 30, Jl. 15	Q 1.50
Erupcion	Boston Curb	*20	*20	*20	Ja. 1, 1928	Q 0.07½
Eureka Bullion	Salt Lake	*86	*80	*81		
Eureka Lilly	Salt Lake	....	....	*33		
Eureka Standard	Salt Lake	....	....	1.42½		
Evans-Wallower	N. Y. Curb	17	15½	16¾		
Evans-Wal., pfd.	N. Y. Curb	70	70	70	Je.20, Jl. 1	Q 1.75
Federal M. & S.	New York	280	245	280	Je., 1927	10.00
Fed. M. & S., pfd.	New York	....	....	101½	My.24, Je.15	Q 1.75
Gladstone	Spokane	....	....	*10½		
Golconda	Spokane	....	....	1.11	Je.15, Jl.1	0.02
Grandview	Spokane	....	....	*42		
Hecla Mining	N. Y. Curb	17⅛	17	17⅛	My.15, Je.15	Q 0.25
Highland-Surprise	Spokane	....	....	*13		
Jack Waite	Spokane	....	....	*9¾		
Kootenay Florence	Spokane	....	....	*14½		
Lucky Jim	Spokane	....	....	*10		
Lucky Tiger-C.	Kansas City	†3.00	†3.25	....	Jl. 5, Jl. 20	0.02½
Mexican Premier	Spokane	....	....	2.35		
National Lead	New York	154	152	152	Je. 14, Je. 29	Q 1.25
Natl. Lead, pfd. A	New York	139½	138½	138½	Mr. 1, Mr. 15	Q 1.75
Natl. Lead, pfd. B	New York	119	118	118	Jy. 19, Au 1	Q 1.50
N. J. Zinc, new	N. Y. Curb	84¾	82½	84¼	Jl.20, Au.10	Q 0.50
New Quincy	Salt Lake	2.07½	2.00	2.00	My.15, My.27	Q 0.10
Noble Five	Spokane	....	....	*62		
North Lily	Salt Lake	7.10	6.65	6.65	Jl.16, Jl.20	Q 0.25
Park Bingham	Salt Lake	8½	8½	8½		
Park Utah	New York	7⅛	7	7	Je. 14, Jl. 10	Q 0.20
Pend Oreille	Spokane	....	....	5.00		
Rico Argentine	Salt Lake	*35	*35	*35	No. 30, De. 15	Q 0.03
Ruth-Hope	Spokane	....	....	*30		
St. Joseph Lead	New York	66½	63	64½	Se.10, Se.20	QX 0.75
Sherman Lead	Spokane	....	....	*44		
Silver King Coa.	Salt Lake	13.25	13.00	13.00	Je. 20, Jl. 1	0.25
Silversmith	Spokane	....	....	*8½	Oct., 1926	Q 0.02
Sunshine Mining	Spokane	....	....	2.98	Je. 10, Je. 20	Q 0.05
Tamarack-Custer	Spokane	....	....	*97	Sept., 1924	0.25
Tintic Standard	Salt Lake	....	....	13.12½	Je. 17, Je. 29	QX 0.30
Tonopah Belmont	N. Y. Curb	....	....	*56½	Oct., 1925	0.05
Treadwell-Yukon	Toronto	9.50	9.50	9.50		
United Zinc Smg.	N. Y. Curb	....	....	*93¾		
Utah Apex	Boston	4	3¾	3¾	May 15, June 1	0.25
Utah Met. & Tun.	Boston	1⅛	1	1⅛	Dec., 1917	0.30
Whitewater	Spokane	....	....	*80		
Yellow Pine	Los Angeles	....	....	*8	Dec., 1925	QX 0.04
GOLD						
Alaska Juneau	New York	6¼	5⅛	5⅛		
Barry-Hollinger	Toronto	*29	*25	*25		
Central Manitoba	Toronto	*44	*40	*44		
Coniaurum	Toronto	....	....	*30		
Cresson Consol.	N. Y. Curb	*68¾	*62½	*62½	Mr.30, Ap.10	Q 0.02
Dome Mines	New York	10	9⅝	10	Jl. 20,	Q 0.25
Golden Cycle	Col. Springs	†1.81½	†1.80½	....	Fe.15, Mr. 1	0.04
Gold Hill	Toronto	*1⅛	*1⅛	*1⅛		
Hollinger	Toronto	5.70	5.55	5.60	Jl.26, Au. 12	FW 0.05
Homestake	New York	75	72	72½	Jl.20, Jl.25	M 0.50
Kirkland Lake	Toronto.	*95	*80	*85		
Lake Shore	Toronto	25.80	24.75	25.00	Je.1, Je.15	Q 0.20
McIntyre-Porc.	New York	15¼	15	15⅛	Au.1, Se.2	Q 0.25
Portland	Colo.Springs	†*10	†*9	....	April, 1927	0.02
Rand Mines	New York	....	....	35	Fe. 21,'28	Am.Sh.1.52
Siscoe	Toronto	*63	*57	*60		
Sylvanite	Toronto	*90	*88	*88		
Teck-Hughes	Toronto	8.50	8.15	8.25	Jl. 18	Au. 1 0.15
Tom Reed	Los Angeles	*60	*53	*60	Dec., 1926	0.02
Unity Gold	N. Y. Curb	1⅛	1⅛	1⅛		
Vipond Consol.	Toronto	*88	*80	*80	April, 1927	0.03
Wright-Hargreaves	Toronto	1.80	1.65	1.79	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb	....	....	35⅛		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	19	18⅛	18⅛		
Castle-Trethewey	Toronto	*30	*30	*30		
Consol. Cortes	N. Y. Curb	....	....	*12½		
Dolores Esperanza	N. Y. Curb	....	....	*87½	July, 1923	0.05
Keeley	Toronto	*49	*46	*46	Mr.15, 1928	0.04
Mining Corp.	Toronto	4.15	4.00	4.00	My.30, Je.13	0.12½
Montana-Idaho	Spokane	*10	*8⅛	*8⅛		
N. Y. & Hond. Ros.	N. Y. Curb	....	....	16½	Jl.17, Jl.27	QX 0.50
Nipissing	N. Y. Curb	2⅛	2⅛	2⅛	Je.29, Jl.20	Q 0.07½
Premier Gold	N. Y. Curb	1¼	1⅛	1⅛	Je.13, Jl.3	Q 0.06
Tonopah Exten.	N. Y. Curb	....	....	*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	3	3	3	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	*62½	*56½	*56½		
Yukon Gold	N. Y. Curb	*75	*62½	*75	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	120½	114½	120	Jl.19, Au.15	Q 1.00
Beth. Steel, pfd, 7%	New York	120	118½	120	Je.1, Jl.1	Q 1.75
Cleveland-Cliffs	Cleveland	155	150	150	Je. 6, Je. 15	5.00
Colo. Fuel & Iron	New York	72⅛	61½	72⅛		
Colo. F. & I., 1st pfd.	New York	133	133	133	My.10, My.25	Q 2.00
Great Northern Iron	New York	31½	30⅛	30⅛	Dec.15,	K 2.00
Inland Steel	New York	96	92	95½	My.15, Jn. 1	Q 0.87½
Republic I. & S.	New York	115	107½	114	My. 11, Je. 1	Q 1.00
Republic I. & S., pfd.	New York	112	112	112	Je .12, Jl. 1,	Q 1.75
Sloss-Sheffield S. & I.	New York	63	63	63	Mr. 11, Mr.20	Q 1.50
Sloss-Sheff. S. & I., pfd.	New York	86	86	86	Je.20, Jl.1,	Q 1.75
U. S. Steel	New York	209⅞	198	207⅛		
U. S. Steel, pfd.	New York	140½	139½	140	My. 4, My 29,	Q 1.75
Virginia I. C. & C.	New York	....	....	23	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	43	41	41	Jl.16, 1928	SA 2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	420	390½	420		
Alum.Co.of Amer., pf.	N. Y. Curb	104⅛	104½	104½	Mr.15, Ap.1,	Q 1.50
American Metal	New York	66	62½	64½	Au. 21, Se. 1	Q 0.75
Amer. Metal, pfd., 6%	New York	122	122	122	Au. 21, Se. 3	Q 1.50
Amer. Sm. & Ref.	New York	109¼	104½	109½	Je. 30, Jl. 12	Q 1.00
Amer. & Sm. Ref., pfd.	New York	134	133½	133½	Au. 3, Se. 1	Q 1.75
Ang. Ch. Nitrate	N. Y. Curb	36⅛	34⅛	35½		
Asbestos Corp.	Montreal	11	10	11	Jan. 1926	1.50
Asbestos Corp., pfd.	Montreal	87	84½	84½	De. 31, Ja. 15	Q 1.75
Consol. M. & S.	Montreal	404	390	395	Je.29, Jl.15,	SAX 6.25
De Beers Consol.	New York	....	....	23	Jl. 23, Jl.26,	Q 0.96
Federated Metals	N. Y. Curb	32½	32½	32½	Je.25, Jl.5	Q 0.75
Freeport Texas	New York	46	42⅛	42⅛	Jl. 5, Au.1	Q 1.00
Int. Nickel Can.	New York	50⅛	48½	48⅛	Je.1, Je.29	Q 0.20
Int. Nickel, pfd.	New York	....	....	122	Jl.1, Au.1	Q 1.75
Mayflower Assoc.	N. Y. Curb	75⅜	71⅛	74⅛		
Metal & Mining	N. Y. Curb	19⅛	19	19	Je.20, Jl.1	Q 0.30
Newmont	N. Y. Curb	216½	206⅛	210	Je.29, Jl.15	Q 1.00
Patiño M. & E.	New York	41⅛	38⅛	40⅛	My. 31, Jn. 28	4a
So. America G. & P.	N. Y. Curb	2⅛	2⅛	2⅛		
Texas Gulf Sulphur	New York	74⅛	71⅛	72⅛	Je.1, Je.15	Q 1.00
U. S. Sm. R. & M.	New York	55⅛	53½	55⅛	Jl. 5, Jl. 15	Q 0.87½
U. S. Sm. R. & M., pfd.	New York	52	50⅛	52	Jl. 5, Jl. 15	Q 0.87½
Vanadium Corp.	New York	96⅜	91	94⅛	Au.1	Au. 15 Q 0.75

Toronto Standard Stock Exchange, Toronto, courtesy the Arthur E. Moysey Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumption. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED July 10, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	61/3	61/3	61/3	Nov., 1926	4p.c.(d)
Aramayo Mines (25 frs.)	61/3	60/3	60/3	May 1929	5p.c.(†)
Burma Corp (10 rupees)	19/—	18/6	18/9	July 1929	9 annas*
Bwana M'Kubwa (5s)	23/3	20/9	22/—		
Camp Bird (2s)	2/4½	2/—	2/3	April, 1928	16⅔ p.c.
El Oro (£1)	3/3	2/10½	3/3	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£)	8/7½	8/7½	8/7½	Jan., 1929	3½ p.c.
Mexican Corpn. (£1)	16/6	14/9	16/4½		
Mexico Mines of El Oro (£1)	6/9	6/—	6/6	Dec., 1926	3⅓ p.c.*(c)
Mount Isa (£1)	44/—	42/10½	43/—		
N'Changa Copper Mining. (£1)	78/1½	70/7½	73/9		
Oroville Dredging (4s)	1/10½	1/6	1/9	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	215/—	185/—	200/—		
St. John del Rey (£1)	17/1½	16/—	17/—	Apr., 1929	7½ p.c.
San Francisco Mines (10s)	37/3	36/6	37/—	June 1929	15 p.c.
Santa Gertrudis (£1)	11/—	10/7½	11/—	July 1929	7½ p.c.
Selukwe (2s. 6d.)	7/1½	4/9	7/—	April, 1917	6⅔ p.c.
S. Amer. Copper (2s.)	3/3	2/10½	3/—	Nov. 1917	75 p.c.
Tanganyika (£1)	59/4½	57/3	58/1½	July, 1928	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	11,100	11,000	11,000	April, 1929	300 fr (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation. (d) U. S. Dollars. (c) July, 1929, ex ½d. return of capital.